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AVIAN MOBbing BEHAVIOR AND PREDATOR RECOGNITION

By STUART A. ALTMANN

Birds sometimes mob their predators even though the predator is not attacking them at the time. The behavior known as "mobbing" has been defined as "a demonstration made by a bird against a potential or supposed enemy belonging to another and more powerful species; it is initiated by the member of the weaker species, and is not a reaction to an attack upon the person, mate, nest, eggs or young" (Hartley, 1950:315).

METHODS

In a series of experiments, stuffed specimens of owls were used to represent predators. The species used were the Screech Owl (*Otus asio*), the Horned Owl (*Bubo virginianus*), the Burrowing Owl (*Speotyto cunicularia*), the Short-eared Owl (*Asio flammeus*), and the Pigmy Owl (*Glaucidium gnoma*). Some of the Screech Owls, Burrowing Owls, and Horned Owls were fairly realistic in appearance. The rest of the owls were typical museum study skins, with their faces turned upward and with cotton eyes. All these specimens differed from live owls in that they were motionless and silent.

The owls were placed either on objects upon which a live owl might perch or on a set of collapsible poles that could be arranged to stand 8, 16, or 24 feet high. The specimens were placed in a wide variety of habitats, including those in which the species that was being used might naturally occur and those where it was presumably absent. Most of the experiments were carried out in various parts of Los Angeles County, California. The remainder were conducted in Tehama, Butte, and Nevada counties of California, and in Washoe County, Nevada.

Certain requisites for the sites of these experiments were established. The sites were in areas which (1) had a population of small birds, (2) were near cover suitable for the birds, (3) were reasonably free from interruptions by people, (4) had not previously been used for such experiments, and (5) were as far as possible from known or suspected nests. The second qualification was adhered to so that the responses of the birds would not be limited. The fourth qualification reduced the possibility of previous conditioning to the site of the experiment, such as was demonstrated by Nice (1943). The fifth requirement was an attempt to avoid the familiar hypersensitivity of birds that are near their nests.

I would like to thank Dr. George A. Bartholomew, Dr. Theodore H. Bullock, Dr. Thomas R. Howell, and Dr. Donald Kalish, of the University of California at Los Angeles, and Dr. William E. Miller, of Ohio State University, for their valuable assistance with various parts of this paper and the research upon which it was based.

RESULTS

Interspecific differences.—Because there are few descriptions of mobbing behavior in the literature, brief descriptions of the "attack" of some of the birds may be useful. Species differ in their mobbing behavior patterns, even in response to the same species of predator. Such interspecific differences will be illustrated by descriptions of the typical behavior of several species when mobbing Screech Owls.

Wren-tits (*Chamaea fasciata*) stayed in the dense shrubbery when mobbing. They fluffed out their feathers and made a sound like a spinning wooden ratchet-wheel. Where the dense shrubbery was continuous around the owl, they approached to within a few inches of the specimen. But when the owl was on a perch surrounded by a small clear space without undergrowth, the Wren-tits approached only as close as they could without entering the clearing; then they called toward the owl from that position. The Wren-tits sometimes continued their agitation for two or three hours.

Audubon Warblers (*Dendroica auduboni*) apparently responded every time they observed one of the owls. In a typical case, the first warbler to attack flew to a perch about two feet from the owl. From there it looked toward the owl, chipping once per second. After some 15 seconds, the warbler flew off into low shrubs 20 feet from the owl, chipping three times per second. The other Audubon Warblers in a radius of about 40 feet around the owl then began chipping rapidly. Two or three of the warblers flew from one shrub to another, staying about 20 feet from the owl, and chipping as they went. The warblers in the shrubs and trees entered by these first warblers began to chip and flutter also. Six or more of the warblers then perched on the tree tops in a circle around the owl, 20 to 30 feet from it, still continuing their chipping and fluttering. Each of them flew from its perch directly toward the owl. When about four feet from the owl, a warbler would turn sharply and fly back to its perch. This flight, which is similar to the insect-catching behavior of this warbler, was repeated by each of the birds about once a minute for 15 minutes, without any apparent correlation in their timing.

One of the most spectacular methods of attack was that used by the Anna Hummingbirds (*Calypte anna*). They flew around the owl, two or three inches from its head, facing it and making little jabbing motions in their flight. Seen from above, these flights would look something like those shown in figure 2d. The bills of the hummingbirds seemed, in all cases, to be directed at the eyes of the owl. While circling around the owl in this manner, they called a short, repeated, high-pitched note.

Flocks of Brewer Blackbirds (*Euphagus cyanocephalus*) circled around the tree that sheltered the owl or stood on the ground facing the owl, repeating a harsh, nasal, call note. Red-winged Blackbirds (*Agelaius phoeniceus*) behaved quite differently. On the one occasion that I tested their reactions to Screech Owls, they sat in the same tree as the owl, the males calling *teeyee* and the females, *chack*. Some of the females and the males with yellow-orange epaulets (yearlings?) fluttered in the air in front of the owl. One of the adult males flew straight at the owl from a distance of 30 feet, swerving sharply a foot in front of the owl, then it flew back to the tree from which it came. Another of the adult males perched silently a foot behind the owl, then leaped out at it, clawing at the top of the owl's head. From there it quickly flew out of the tree, fluttered behind the owl for half a minute, and then returned and repeated its clawing action. After four such attacks, this blackbird flew to a nearby tree and called a rapid *chick-adick* several times. At the end of this experiment, a small bald spot had been clawed on the top of the owl's head.

Failure to mob.—Members of some species never attacked any of the owls that were presented to them, except occasionally during the breeding season, or when other birds had already begun to mob an owl. For example, a Brown Towhee (*Pipilo fuscus*) spent a half-hour hunting and feeding within eight feet of a conspicuous, realistic Horned Owl specimen, sometimes approaching to within three feet of it, without reacting in any way that was distinguishable from the Brown Towhee's usual feeding behavior.

During another experiment, two California Thrashers (*Toxostoma redivivum*) had been feeding in the duff at the base of a leafless bush. Three feet above them was a mounted Screech Owl. When other birds began to mob the owl, the thrashers stopped

feeding and remained standing in one place, occasionally cocking their heads from side to side. Twenty minutes later, when the other birds had quieted down and flown away, the thrashers resumed their feeding, still only four feet from the owl, and with an unobstructed view of it. This occurred during the breeding season of the thrashers.

Few data on failure to respond were obtained because of the difficulty in determining whether birds that did not respond actually saw the owls.

Taxonomic correlation.—No correlation of the presence or absence of mobbing behavior with taxonomic relations has been detected in this study. Three factors may be responsible for this: The sampling may be too limited to show any correlations that do exist. The behavior may be learned. Mobbing may have arisen independently several times in the evolution of avian behavior.

Intraspecific differences.—There are intraspecific differences in the mobbing reactions to the same predator, as well as the interspecific differences mentioned previously. Thus, not all of the Audubon Warblers that reacted perched on the tree tops and flew at the owl. Some of them stayed in the lower branches and called at the owl, occasionally flying to other branches. Among the Red-winged Blackbirds, there were several behavior patterns, depending upon the age and sex of the individuals. In addition, several species were found in which some of the members mobbed but others did not. Certain implications of such variation will be discussed later.

Reactions to various predators.—In addition to the inter- and intraspecific differences in the mobbing reactions to the same predator, already discussed, there is the possibility of inter- and intraspecific differences in reactions to different species of predators. Intraspecific differences in reactions to different species of predators would be indicated by a marked difference in reactions to one species of predator as opposed to another. No such difference was detected nor were interspecific differences.

Table 1
Seasonal Changes in Mobbing Behavior

Month	Bird-minutes of reaction/minute of trial			
	All experiments		Santa Monica Mountains	
January	59/263	0.224	59/63	0.936
February	8/90	0.089	8/75	0.106
March	409/663	0.611	366/140	2.61
April	389/523	0.744	337/290	1.16
May	667/352	1.90	341/70	4.87
June	220/50	4.40	0/0	.....
July	0/65	0.00	0/0	.....
August	0/67	0.00	0/0	.....
September	0/20	0.00	0/0	.....
October	0/0	.....	0/0	.....
November	2/190	0.010	0/0	.....
December	155/204	0.759	140/146	0.959

Seasonal differences.—There are seasonal changes in the numbers of birds that will mob a predator and in the duration of their mobbing, as shown in table 1. "Bird-minutes of reaction/minute of trial" designates the sum of the number of minutes that each bird reacted divided by the number of minutes involved in the experiment. These seasonal differences cannot be explained by corresponding fluctuations in the numbers of birds in the area. The influx of winter residents into southern California would, if anything, result in a greater number of bird-minutes of reaction per minute of trial during the

winter. The spring increase is probably due to seasonal changes in hormone concentrations associated with breeding activities.

Contagious reactions.—Not all the reactions observed in these experiments were responses to the owls themselves. Birds will often respond "by contagion" to the reactions of other birds. If an owl is being mobbed by a group of birds, other birds that cannot, because of their position, see the owl will also begin calling and fluttering. Contagious reactions are the basis for the large aggregations that sometimes form around predators.

Such responses to reactions can be very remarkable. During an experiment on a part of the campus of the University of California at Los Angeles in the winter of 1952, the responses of 6, out of a flock of 200, Audubon Warblers to the sight of a Pigmy Owl excited apparently all the other members of the flock.

Birds also reacted to the calls of birds of other species. Large mixed aggregations sometimes formed shortly after the first bird had begun to attack.

The range of the number of species of birds actually attacking the owls was from 1 to 7, with a mean of 2.13. The number of individuals ranged from 1 to 29, with a mean of 6.1. The number of bird-minutes of reaction ranged from 1 to 300, with a mean of 63.7.

Birds of some species reacted "by contagion" but not spontaneously, except during the breeding period. In the case of the Brown Towhees, this reaction consisted of nothing more than a soft chirping and a flicking movement of the tail.

After one bird or group of birds has begun to mob an owl that is readily visible, there is usually no way to determine whether the behavior of the other mobbing birds is triggered by the sight of the owl or by the reactions of these first birds. The reactions of the birds of the first species to begin mobbing in any experiment will be designated as "primary reactions," and the reactions of the birds of all subsequent species will be designated as "secondary reactions." A primary reaction is never a reaction by contagion; a secondary reaction may or may not be. If the members of a species are never the first to mob (never primary), but do mob after others have begun (secondary), the reactions are probably triggered only by the reactions of other birds (contagious reactions).

Spatial orientation.—One day in May, 1953, an Anna Hummingbird had been attacking a Screech Owl in the manner described. The hummingbird had flown out of sight. Without waiting to see whether it would return, I took the owl from its perch. When the owl had been carried about five feet from the perch, the hummingbird returned and circled around the place where the owl had been, making the same jabbing movements. Similar spatial orientation has been reported in the Blue Tit, *Parus caeruleus* (Hinde, 1954:330), the English Robin, *Erithacus rubecula* (Lack, 1953:160), the House Finch, *Carpodacus mexicanus* (Howard, 1935:42), and the Bewick Wren, *Thryomanes bewickii* (Selander, 1955:64).

Another peculiarity of mobbing birds is that a human can approach nearer to them than usual. I have stood three feet or less from Wren-tits, Bush-tits (*Psaltriparus minimus*), and Anna Hummingbirds while they were mobbing Screech Owls.

DISCUSSION

In the presence of a predator, a bird may do one of several things. It may fly into dense foliage or fly away. It may remain within sight of the predator, but indicate by its voice or actions that it has recognized a foreign object in its environment. It may not respond to the predator at all. It may attack the predator. The first three types of reactions are not restricted to predators, but are the typical responses of birds to a wide variety of objects. In contrast, the attacks of birds known as "mobbing behavior" are almost entirely restricted to natural enemies or to stimuli resembling them. As an exam-

ple, Schaefer (1953:425) found that among Swallow-Tanagers (*Tersina viridis*) "the only bird of prey specifically recognized and really feared was the Bat Falcon (*Falco albigularis*)," which may be the only serious predator of the Swallow-Tanager. Because of this restriction, "predator recognition" and "mobbing behavior" are used synonymously in this paper. Neither term is intended as anything more than an abbreviated description of the birds' behavior.

The character or characters of a predator to which members of the prey species respond are designated as "stimulus characters." If they are found only in one species of the predators of the animal in question, they will be designated as "specific." If they are found in more than one species of predator, they will be designated as "interspecific."

The properties of stimuli that are designated by the terms "specific" and "interspecific" are completely independent of the complexity of the stimulus (Tinbergen, 1951). These terms refer to the taxonomic distribution of the stimulus characters, not to their components; the features of an owl to which another bird reacts may be either very simple or very complex, regardless of whether or not these characters are found in other species of predators.

The methods for studying the configurational nature of the sign stimuli of reactions of birds to birds of prey have been presented by Goethe, Krätzig, Lorenz (reviewed by Tinbergen, 1951:31, 54, 77), Nice (1943), Nice and ter Pelkwyk (1941), and Hartley (1950). These methods are adaptable to a study of the specificity of the stimulus characters. Such a study would, however, involve testing the responses to the components of the stimulus for each of the species of predators. If, for example, an Audubon Warbler mobbed both Horned Owls and Screech Owls, it does not necessarily follow that the Horned Owls and the Screech Owls have a common stimulus character or pattern of characters. It is also possible that the Horned Owls have one set of sufficient stimulus characters and the Screech Owls have a partially or totally different set.

Thus, any study of reactions of birds to predator models that are essentially complete in terms of visible external characters cannot fully delimit the specificity of the stimulus characters. It can, however, set certain limits on such a determination; it can partially solve the problem. How this can be accomplished will be discussed in conjunction with the heritable aspects of mobbing behavior. The application of the method to the available data is summarized in table 2.

It should be borne in mind that this paper is based on a study of sufficient, rather than necessary stimuli, and that there may be sufficient stimuli for mobbing other than the particular visual stimuli on which these experiments depended. Miller (1952) got responses from many birds to his excellent imitations of owl calls, indicating that auditory stimuli may be sufficient.

The heritability of mobbing behavior and the specificity of the stimuli can be deduced from certain information, including a knowledge of which species of owls the birds had seen in these experiments, whether or not they had mobbed the owls, the location of the experiments, and what species of predators each bird may have encountered previously.

There are four possible relations of experience of a species of prey and of a given individual of that species, with a species of predator. It may be that neither the individual nor any other member of its species encounters this species of predator (relation I, fig. 1a); or that some of the members of the species, but not this particular member, encounter this species of predator (relation II, fig. 1b); or that some members of this species, including this member, encounter this species of predator (relation III, fig. 1c); or that this member of the species of prey, but no other, encounters this species of predator. The last case is so unlikely to occur in nature that it will not be considered.

The best available criteria for distinguishing these three relations are the ranges of the members of each species and the relative distribution of each species of predator and prey. The distinctions are probably more accurate for crepuscular and diurnal owls, but even the completely nocturnal forms are sometimes discovered by birds during the day. Range and distribution data were obtained primarily from Grinnell and Miller (1944).

In addition to agreeing with the definition of mobbing behavior given at the beginning of this paper, the reactions that will be used must comply with two other qualifications. First, the reactions must be primary ones. This qualification avoids the possibility that the birds' reactions were triggered, not by the sight of the owl, but by the reactions of the birds that were already mobbing. Second, the data must be obtained outside of the breeding season. During the period of breeding activities, many birds will attack almost any strange object.

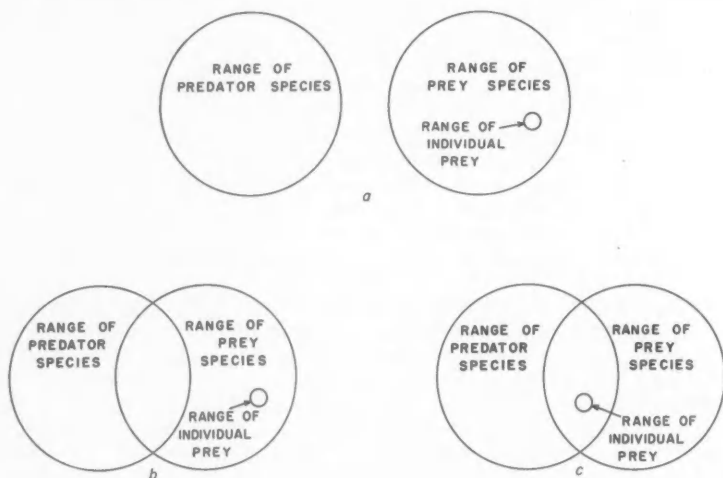


Fig. 1. Relations of experience of prey species and prey individuals with species of predators (see text). *a*, Relation I; *b*, Relation II; *c*, Relation III.

Relation I.—The reactions of a bird to an owl of a species which neither it nor any other member of its species encounters (relation I, fig. 1*a*) could not be a learned reaction in response to characters that are found only in this species of owl (specific characters). No opportunity for such learning has existed.

In addition, if relation I represents the relation between the two species during the evolution of the present behavior of the species of prey, a response to specific stimuli could not have been selected for. Also if such a complex behavior pattern is inherited, there is little chance that it could have originated by any non-selective mechanism such as drift and mutation pressure. Since a reaction to a specific stimulus pattern could not have been inherited or learned in this relation, the conclusion may be made that those reactions which do occur cannot be reactions to specific stimuli.

This reaction to interspecific stimuli could have been learned or selected for by previous experience of this individual or this species with other species of predators having the interspecific characters.

A bird that mobs an owl which neither it nor any other member of its species encounters is not mobbing one of its potential predators. Consequently, the definition of mobbing behavior that has been given includes the phrase "or supposed enemy," and the term "encounters" (a species of owl) that is used in this discussion does not necessarily mean "encounters in an attack," but only "experiences."

An assumption made in this and subsequent discussions is that mobbing reduces the frequency of predation. If this is true, mobbing behavior has a positive selective value. Unfortunately, there are not sufficient data available to determine the accuracy of this assumption.

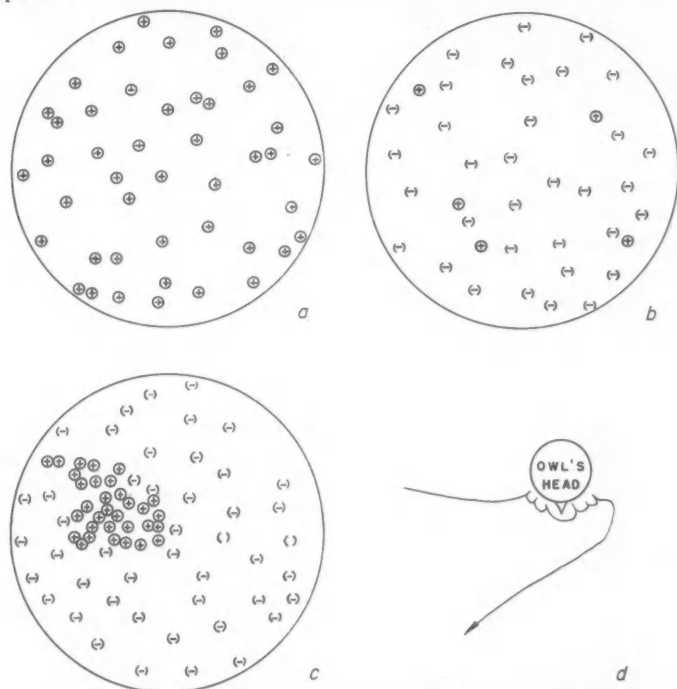


Fig. 2. *a*. All adults giving primary reaction outside of breeding period. *b*. Scattered adults giving primary reaction outside of breeding period. *c*. Localized adults giving primary reaction outside of breeding period. *d*. Path of Anna Hummingbird attacking Screech Owl.

If the results of a large number of experiments are plotted on a map of the distribution of the species, using the symbol "+" for primary mobbing reactions outside of the breeding season, and "-" for all failures to respond, and if the data assumes a pattern like that of figure 2*a*, the behavior is probably inherited. This is true only if the opportunity for conditioning does not occur in all members of the species. This seems to be a reasonable assumption for wild birds, although again, documentation is lacking.

Lehrman (1953) has criticized the concept of innate behavior, pointing out that stereotyped reactions depend upon certain previous environmental conditions. The fact

that stereotyped reactions occur within the context of an environmental background that does not include either cultural heritage or previous experience with the particular stimulus pattern in question makes it probable that such reactions depend upon a fairly specific genetic background, not just a generalized modifiability. Such reactions are therefore termed "innate" or "inherited." If these reactions vary and if they affect the reproductive differential, they are subject to evolution.

If some of the birds of a species react and others do not, the members of these two classes may be randomly distributed geographically, as shown in figure 2*b*, or they may be localized, as shown in figure 2*c*. If the distribution is random, the responses are probably learned. If the reactions are more localized than the species of predators having the interspecific characters, but not so localized that they might all be accounted for by previous experience with a single owl, the birds in such a local population probably have an innate mobbing behavior. Such a situation would be difficult to detect in the field. As in the case of the species represented by figure 2*a*, in which all members react, it seems doubtful that all the members of this population could have encountered an owl of this or a similar species before the experiment was performed. An analysis of universality as a criterion of instinctive behavior has been given by Riess (1950).

Experiments may reveal a species of bird that will instinctively mob only a species of predator which no member of this species of prey encounters. The range of the species of predator may have overlapped that of the species of mobbing bird at some time in the past, or such a reaction may be a response to characters common to both this species of predator and an extinct species which the ancestors of the modern bird encountered. Such stimulus characters are interspecific only in a temporal sense.

In summary, if a bird mobs a species of predator that neither it nor any other member of its species has ever seen (relation I), the stimulus characters are interspecific. If an entire population of this species of bird (either all or a part of the total species, figs. 2*a* and 2*c*) mobs such a predator, the reaction is hereditary. If those members of the species that mob and those that do not are randomly distributed through the population (fig. 2*b*), the behavior is learned.

Relation II.—If a bird mobs a species of predator which it has never seen before, but which other members of its species have seen (relation II), the reaction may have been learned by experience with other species of predators that share an interspecific stimulus character or combination of characters. In the case of such a learned behavior pattern, the stimulus characters could not be specific; no opportunity for such learning has occurred.

If the behavior is innate, it may have been selected for in previous encounters with predators of the species in question, or of other species sharing an interspecific pattern with this species. Thus, the only possibility that has been eliminated in this situation is that of a learned response to specific stimulus characters.

The geographic distribution of the birds that mob and those that do not can again be used to determine whether the behavior is learned or innate.

In this as in the other relations, if the members of a species of bird fail to mob all other species of predators, the stimulus characters are specific.

Relation III.—If a bird mobs a species of predator which may previously have been encountered by this bird and by other members of this species (relation III), the behavior may be either innate or learned, and the stimulus characters may be either specific or interspecific. In addition, either type of behavior may be a response to either type of stimulus pattern. If such reactions occur among members of the species only in the region where the species of owl is found, the reaction is probably learned. Again, a failure to mob any other species of predator implies a specific set of stimulus characters.

Data on heritability and specificity.—The data that have been obtained and the conclusions that have been drawn from them are summarized in table 2. Many more data will have to be obtained before any final conclusions can be drawn. The symbols and designations in this table are as follows:

Order of reactions.—Primary reactions are indicated by "p"; secondary reactions, by "s."

Relation.—The relation between the species and the individual whose reactions were tested, and the species of owl are indicated by roman numerals. These correspond to the three relations described in this paper and shown in figures 1a, 1b, and 1c. The letter "B" indicates reactions during the breeding period.

Conclusion.—Species of owls to which primary mobbing reactions were given outside of the breeding period are indicated by capitals. Species of owls that were not mobbed are printed in lower case. Except where otherwise indicated, the data are not sufficient to determine whether the characters to which the birds responded are interspecific (indicated by "intersp.") or not. "Indet." (indeterminate) refers to data that are not sufficient to support any conclusion.

SUMMARY AND CONCLUSIONS

Descriptions of the mobbing behavior of several species of wild birds are given based on behavior shown to the same and to different species of mounted owls. There is a vernal increase in the number of birds that mob.

The presence or absence of mobbing behavior could not be correlated with taxonomic position.

Spatial orientation of mobbing birds is described, and their insensitivity to the presence of man is indicated.

Of the 39 species that have been observed, the members of 5 species initiated 10 mobbing reactions outside of the breeding season. Nine of these reactions were to species of owls that occur in the area in which the observations were made (relation III), while one was a reaction to a species of owl that is encountered only by other members of the species (relation II). The members of 13 species initiated 20 mobbing reactions during the breeding period. Six of these reactions were to species of owls that are sympatric with members of the species other than the one that reacted (relation II). One of the reactions fell into the relation I group; the remaining 13 were of the relation III type. Members of 13 species attacked owls after members of other species had initiated the attacks. In 19 species, no member that was tested mobbed any of the owls that were presented to it.

A method is outlined for determining whether mobbing behavior is learned or innate. The primary criterion is the universality of mobbing behavior among populations of birds that probably have not previously been exposed to the stimuli that elicit their mobbing. More data that fit the criteria have been obtained for Audubon Warblers than for any other species that has been tested; for this species, the hypothesis that mobbing is innate is proposed.

The origin and perpetuation of the type of gene complex that would underlie innate mobbing behavior depend upon a decreased probability of predation on those birds, or the offspring of those birds, that mob their predators.

Table 2
Heritability and Specificity Data

Species tested	Owl used	Presence of mobbing behavior	Order of reactions	Date	Time	Relation	Conclusion
Mourning Dove (<i>Zenaidura macroura</i>)	Screech	—	—	3-28-53,	4:35 p.m.	.....	Screech
Chinese Spotted Dove (<i>Streptopelia chinensis</i>)	Pigmy	—	—	5-17-52,	8:29 a.m.	.....	Pigmy
Costa Hummingbird (<i>Calypte costae</i>)	Sh.-eared	+	s	4-4-52,	2:17 p.m.	.....	indet.
	Sh.-eared	+	s	4-4-52,	2:36 p.m.	.....
Anna Hummingbird (<i>Calypte anna</i>)	Sh.-eared	+	p	4-4-52,	1:56 p.m.	IIB	Screech
	Screech	—	—	3-28-53,	1:07 p.m.	.....	Mobbed during
	Screech	+	s	3-28-53,	4:04 p.m.	.....	the breeding
	Screech	—	—	3-28-53,	4:33 p.m.	.....	season or
	Screech	+	s	4-29-53,	8:03 a.m.	.....	secondarily
	Screech	+	s	5-24-53,	6:21 a.m.	.....
	Pigmy	+	p	3-13-52,	4:00 p.m.	IIB	
Allen Hummingbird (<i>Selasphorus sasin</i>)	Pigmy	—	—	3-21-53,	12:10 p.m.	.....	Pigmy
Calliope Hummingbird (<i>Stellula calliope</i>)	Pigmy	+	p	8-4-52,	9:45 a.m.	III	PIGMY
Red-shafted Flicker (<i>Colaptes cafer</i>)	Screech	—	—	11-23-51,	3:50 p.m.	.....	Screech,
	Burrow.	—	—	3-22-52,	11:18 a.m.	.....	Burrowing
Black Phoebe (<i>Sayornis nigricans</i>)	Screech	+	p	5-25-52,	9:05 a.m.	IIIB	Indet.
Western Flycatcher (<i>Empidonax difficilis</i>)	Screech	—	—	5-9-53,	8:25 a.m.	.....	Screech
Western Wood Pewee (<i>Contopus richardsonii</i>)	Screech	—	—	8-23-53,	10:40 a.m.	.....	Screech
Scrub Jay (<i>Aphelocoma coerulescens</i>)	Sh.-eared	—	—	4-4-52,	2:11 p.m.	.....	Sh.-eared, Screech
	Screech	—	—	4-12-53,	11:13 a.m.	.....	Mobbed
	Screech	+	s	5-24-53,	6:21 a.m.	.....	secondarily
Clark Nutcracker (<i>Nucifraga columbiana</i>)	Screech	—	—	8-9-53,	8:26 a.m.	.....	Screech
Mountain Chickadee (<i>Parus gambeli</i>)	Burrow.	—	—	8-30-53,	11:20 a.m.	.....	Burrow.
	Burrow.	—	—	8-30-53,	11:35 a.m.	.....
Bush-tit (<i>Psaltiriparus minimus</i>)	Sh.-eared	+	p	4-4-52,	2:10 p.m.	IB	Screech
	Screech	+	p	3-19-53,	4:04 p.m.	IIIB	Mobbed only
	Screech	+	s	4-12-53,	11:59 a.m.	.....	during the
	Screech	+	s	4-29-53,	8:01 a.m.	.....	breeding season
	Screech	—	—	11-23-51,	10:15 a.m.	.....	or secondarily
	Pigmy	+	s	3-8-52,	10:19 a.m.	.....
	Pigmy	+	p	3-13-52,	4:08 p.m.	IIB	
Brown Creeper (<i>Certhia familiaris</i>)	Burrow.	—	—	8-30-53,	12:00 m.	.....	Burrow.

Species tested	Owl used	Presence of mobbing behavior	Order of reactions	Date	Time	Relation	Conclusion
Wren-tit (<i>Chamaea fasciata</i>)	Screech	—	—	4-4-53,	12:50 p.m.	.....	Screech
	Screech	—	—	4-4-53,	2:15 p.m.	.....	Mobbed only
	Screech	+	p	4-4-53,	2:45 p.m.	IIIB	during the
	Screech	—	—	4-4-53,	2:49 p.m.	.....	breeding season
	Screech	+	p	4-12-53,	11:53 a.m.	IIIB	or secondarily
	Screech	—	—	4-29-53,	10:31 a.m.	.....
	Pigmy	+	p	3-8-52,	10:18 a.m.	IIB	
	Pigmy	+	s	3-13-52,	4:25 a.m.	.....
	Pigmy	+	s	12-18-51,	2:12 p.m.	.....
Mockingbird (<i>Mimus polyglottos</i>)	Screech	—	—	5-25-52,	9:10 a.m.	.....	Screech
	Screech	+	s	5-30-53,	8:03 a.m.	.....	Mobbed only
	Screech	—	—	12-1-51,	11:53 a.m.	.....	during the
	Burrow.	+	p	3-22-52,	9:43 a.m.	IIB	breeding season or secondarily
California Thrasher (<i>Toxostoma redivivum</i>)	Screech	—	—	4-12-53,	12:15 p.m.	.....	Screech
American Robin (<i>Turdus migratorius</i>)	Burrow.	—	—	3-22-52,	11:10 a.m.	.....	Burrow.
Swainson Thrush (<i>Hylocichla ustulata</i>)	Screech	—	—	4-12-53,	10:15 a.m.	.....	Screech
	Screech	+	s	4-12-53,	11:55 a.m.	.....	Mobbed only secondarily
Ruby-crowned Kinglet (<i>Regulus calendula</i>)	Burrow.	—	—	3-22-52,	11:13 a.m.	.....	Burrow.
Bell Vireo (<i>Vireo belli</i>)	Screech	+	p	4-18-53,	8:20 a.m.	IIIB	Indet.
	Screech	+	p	4-29-53,	8:00 a.m.	IIIB	
Solitary Vireo (<i>Vireo solitarius</i>)	Screech	—	—	8-23-53,	10:43 a.m.	.....	Screech
Warbling Vireo (<i>Vireo gilvus</i>)	Screech	—	—	5-9-53,	8:27 a.m.	.....	Screech
Yellow Warbler (<i>Dendroica petechia</i>)	Screech	—	—	4-18-53,	8:35 a.m.	.....	Screech
Audubon Warbler (<i>Dendroica auduboni</i>)	Screech	+	p	12-23-51,	3:57 p.m.	III	SCREECH,
	Horned	+	p	1-22-52,	3:25 p.m.	III	HORNED,
	Horned	+	p	12-18-51,	2:10 p.m.	III	PIGMY
	Pigmy	+	p	1-11-52,	4:05 p.m.	III	Hereditary?
	Pigmy	+	s	3-13-52,	4:22 p.m.	.....
	Pigmy	+	p	12-18-51,	2:10 p.m.	III	
Hermit Warbler (<i>Dendroica occidentalis</i>)	Burrow.	—	—	8-30-53,	11:20 a.m.	.....	Burrow.
English Sparrow (<i>Passer domesticus</i>)	Pigmy	—	—	5-17-52,	8:08 a.m.	.....	Pigmy
	Pigmy	—	—	5-17-52,	1:00 p.m.	.....
Red-winged Blackbird (<i>Agelaius phoeniceus</i>)	Screech	+	p	6-4-53,	3:00 p.m.	IIIB	Indet.
Brewer Blackbird (<i>Euphagus cyanocephalus</i>)	Screech	+	p	5-30-53,	8:00 a.m.	IIIB	Indet.

Table 2 (continued)

Species tested	Owl used	Presence of mobbing behavior	Order of reactions	Date	Time	Relation	Conclusion
Cowbird (<i>Molothrus ater</i>)	Screech	—	—	5-25-52,	9:22 a.m.	Screech, Pigmy
	Pigmy	—	—	5-17-52,	8:51 a.m.	.....
Black-headed Grosbeak (<i>Pheucticus melanocephalus</i>)	Screech	—	—	4-29-53,	9:15 a.m.	Screech
	Screech	—	—	4-29-53,	11:28 a.m.	.....
	Screech	—	—	5-24-53,	6:05 a.m.	.....
	Screech	+	p	5-24-53,	6:20 a.m.	IIIB	
House Finch (<i>Carpodacus mexicanus</i>)	Screech	+	p	3-28-53,	4:04 p.m.	IIIB	Screech, Pigmy Mobbed during the breeding season or secondarily
	Screech	—	—	5-25-52,	9:12 a.m.	.....
	Screech	+	s	5-30-53,	8:01 a.m.	.....
	Screech	—	—	12-1-51,	11:25 a.m.	.....
	Screech	—	—	12-1-51,	11:45 a.m.	.....
	Pigmy	—	—	5-17-52,	9:05 a.m.	.....
Spotted Towhee (<i>Pipilo maculatus</i>)	Pigmy	—	—	5-17-52,	2:00 p.m.	.....
	Screech	+	s	4-12-53,	11:55 a.m.	HORNED, PIGMY
	Screech	+	p	4-29-53,	9:57 a.m.	IIIB	
	Horned	+	p	2-23-52,	10:10 a.m.	III	
	Pigmy	+	p	2-23-52,	9:40 a.m.	II	
Brown Towhee (<i>Pipilo fuscus</i>)	Sh.-eared	+	s	4-4-52,	2:16 p.m.	Screech, Horned, Pigmy
	Sh.-eared	+	p	4-29-52,	1:05 p.m.	IIIB	
	Screech	—	—	4-4-53,	10:46 a.m.	Reacted only dur- ing the breeding season or secondarily
	Screech	—	—	4-29-53,	12:00 m.	.....
	Screech	+	p	5-24-53,	6:21 a.m.	IIIB	
	Screech	+	s	5-30-53,	8:08 a.m.	.....
	Horned	—	—	1-22-52,	3:55 p.m.	.....
	Burrow.	—	—	3-22-52,	10:16 a.m.	.....
	Pigmy	+	s	1-11-52,	4:09 p.m.	.....
	Pigmy	+	s	3-13-52,	4:36 p.m.	.....
	Pigmy	—	—	5-17-52,	1:15 p.m.	.....
	Pigmy	—	—	5-17-52,	8:47 a.m.	.....
Savannah Sparrow (<i>Passerculus sandwichensis</i>)	Pigmy	+	s	3-13-52,	10:55 a.m.	Indet.
Golden-crowned Sparrow (<i>Zonotrichia atricapilla</i>)	Screech	+	p	3-28-53,	4:25 p.m.	III	SCREECH
Song Sparrow (<i>Melospiza melodia</i>)	Screech	—	—	3-28-53,	4:01 p.m.	HORNED
	Screech	+	s	3-28-53,	4:04 p.m.	.....
	Screech	+	p	5-9-53,	9:03 a.m.	IIIB	
	Screech	+	s	5-24-53,	6:21 a.m.	
	Horned	+	p	2-23-52,	10:55 a.m.	III	

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POPULATION STRUCTURE IN SALT MARSH SONG SPARROWS PART II: DENSITY, AGE STRUCTURE, AND MAINTENANCE

By RICHARD F. JOHNSTON

This is the second part of a report on the population ecology of the Song Sparrows (*Melospiza melodia*) living on the salt marshes of the north part of San Francisco Bay. Part I (Johnston, 1956) dealt with a description of the environment of salt marsh Song Sparrows and with their breeding behavior and movements. This part treats demographic considerations.

POPULATION DENSITY

There are several ways to describe the relationships between numbers of Song Sparrows and the area in which they live. The figure of 105 pairs of Song Sparrows per 100 acres given earlier (Johnston, 1952:316) for the population here discussed does not indicate the true density this species maintains, for the areal reference in this measurement was for a total study plot, 80 to 90 per cent of which Song Sparrows do not inhabit. However, this density figure is comparable to certain figures recorded by workers in population ecology and thus has relative meaning.

As described previously, salt marsh Song Sparrows live along tidal sloughs and except in places where the sloughs double back on themselves the territories of the birds are strung out one by one along the lengths of the sloughs. The birds thus occupy effectively only a fragment of the total marsh (fig. 1). Sporadic foraging or trips to gather nesting material occur in the regions between the sloughs, and dispersing juveniles must also cross these areas, but in a practical sense these areas of short *Salicornia* are not used by the birds. If a marsh is totally grown to short *Salicornia*, the Song Sparrows are not resident there (Marshall, 1948a:214).

Table 1 shows the relationships between numbers of birds and the lengths and areas of four major sloughs on San Pablo marsh in the breeding season of 1953, a year of high density. The areal calculation for each slough was made by multiplying the length of the slough by 30 feet. Thirty feet represents the average width of territories along sloughs within which the birds perform practically all their activities. At high water a 6- to 10-foot strip of water is present, but at lower levels a great deal of mudbank is exposed; this last is, of course, ideal Song Sparrow foraging area. With this as the definition of the area in which Song Sparrows live, the actual density in a year of high numbers is seen to run from 8 to 10 pairs per acre. This is not as unreasonable as it may seem, for 10 pairs of Song Sparrows per acre would give each pair about 4350 square feet per territory; this amounts to a rectangular plot about 30 by 150 feet on the sides. This is the size of many territories on the marsh, although some are smaller and some larger.

Figure 1 outlines the changes in territorial utilization of the area along one of the major sloughs ("A") on the marsh for five successive breeding seasons. This can be taken as exemplary of the similar shifts in placement and number that occurred in other parts of the marsh. The shifts themselves are of interest, but perhaps the most significant thing illustrated in the figure is that there is a clear difference in size of breeding territories in relation to the vegetational configuration of the immediate area.

In the *Spartina* zone territories are larger than those in the *Salicornia* zone. However, at the heads of the sloughs the height and amount of vegetation, especially that of *Grindelia*, is reduced, and territories here are larger than those in the mid-marsh areas of lush vegetation. For these reasons the two longer sloughs listed in table 1 have a lower density than the shorter sloughs. Both B and H have long stretches in the *Spartina*

zone and both have at least two arms leading to the less complex vegetation of the upper portions of the sloughs.

In the six-year period from 1950 to 1955 the number of Song Sparrows on the marsh plot remained relatively constant. Table 2 lists the changes in breeding density observed for this period of time. The largest change was a 24 per cent increase for 1953 over 1952. All other changes of density are of a low order of magnitude. Figures for the years 1950 and 1951 are extrapolations from counts for smaller areas, as accurate counts were made of only a portion of the plot used in later years.

Table 1

Linear and Actual Density of Song Sparrows on San Pablo Marsh in 1953

Slough	Length (feet)	Acres ¹	Pairs of Song Sparrows	Density Linear ²	Actual ³
A	3060	2.1	22	139	10.5
B	3575	2.5	24	153	9.7
C	2400	1.6	17	130	10.4
H	4480	3.0	25	170	8.2

¹Length of slough \times 30 feet. ²Number of feet per pair. ³Number of pairs per acre.

The greatest change in density recorded in table 2, that in 1953, was not, by ordinary populational standards, a large increase; likewise none of the decreases were large. It may thus be assumed that this population exists in fair equilibrium with its environment. Nonetheless, the fluctuations in density were not random in character. The changes can be related to the productivity of the previous year (fig. 2).

Table 2

Changes in Density of Song Sparrows on 100 Acres of Salt Marsh

Year	Pairs of breeding adults	Change in density in per cent of previous year
1950	87 ¹	—
1951	90 ¹	3
1952	100	10
1953	124	24
1954	118	5
1955	102	14

¹Estimates based on counts of smaller areas.

Figure 2 plots both productivity and population density against time. The ordinate on the left represents population density in the several years as percentages of the density recorded for 1952; the ordinate on the right, an entirely different scale, represents yearly productivity in absolute numbers. The two curves allow direct comparison between productivity for a given year and the subsequent year's population density. It is apparent that high productivity can be correlated with a succeeding rise in population density, for in every case an increase or decrease in density is preceded by an increase or decrease in the productivity of the year before. Whereas this apparently causal relationship is not surprising, it has not heretofore been demonstrated among passerine birds and Gibb (1954:42) has shown that it does not hold for Great Tits (*Parus major*) and Blue Tits (*Parus caeruleus*) in the English midlands.

There is no demonstrable reverse relationship among salt marsh Song Sparrows; that is, density does not seem to influence the same year's productivity. Many previous

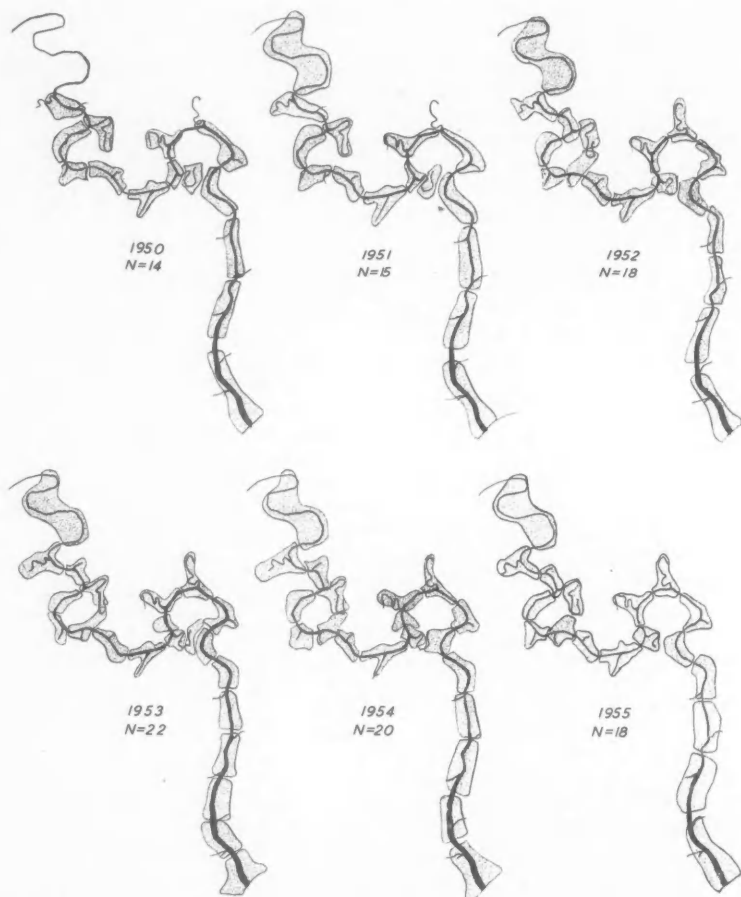


Fig. 1. Breeding territories of salt marsh Song Sparrows along one tidal slough ("A").

workers have made an effort to show that density is its own automatic control, and the argument now is strong that extremely high densities by their very nature react upon themselves so as to cause or guide a reduction in density. But, most populations of vertebrate animals in temperate regions never reach extreme densities. Thus, in these Song Sparrows the relatively small variation in density from year to year appears not to influence a subsequent year's density. The influence of such things as the number and size of useable territories is probably stringent enough that the maximum density is never "high," any excess of individuals spilling out into marginal areas, and the habitat is not strained as a result.

Factors that may regulate productivity are the number of times a pair of birds nests per season, the size of the clutch, and egg and nestling mortality. Mortality in older age

classes will be shown to remain about the same from year to year; this includes mortality subsequent to the age of five months. All the causes of mortality (p. 266 ff) have been found to operate independently of population density. Actually, clutch-size is the only one of these influential factors that has been found to be related in some way to density.

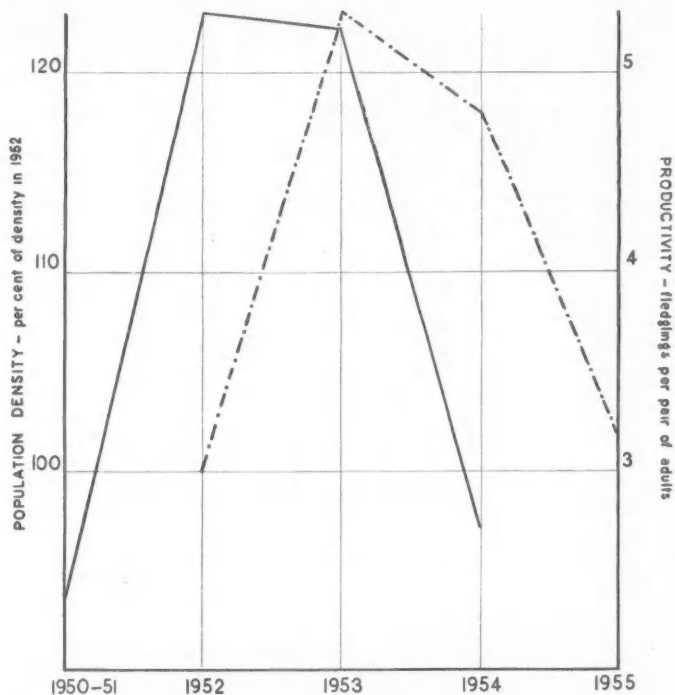


Fig. 2. The relationship between population density (broken line) and productivity (solid line) in salt marsh Song Sparrows.

The relationship of breeding density to clutch-size is examined in figure 3. The ordinate on the left presents population density in terms of the density recorded for 1952; the ordinate on the right presents clutch-size in terms of percentages of the figures for 1952. There is a tendency for clutch-size to increase or decrease inversely as density decreases or increases. This relationship has been noted once before in birds, among Great Tits, by Kluijver (1951:79ff). Kluijver was able to relate this variation in clutch-size to productivity ("fecundity"), and thus was able to say that it was a self-limiting aspect of the numbers of a natural population. In salt marsh Song Sparrows the situation is not at all equivalent, for annual variation in clutch-size is not related to annual variation in productivity (table 9). Moreover the variation in mean clutch-size is of such limited nature that by itself it could hardly affect productivity relationships in successive years so that they would be considered significant by any statistical standard. Thus a curious situation arises: with a probable inverse relationship existing between

density and clutch-size it is not possible to say that the relationship has any significance, because of the absence of relationship between productivity and clutch-size (table 9).

Whether or not it lacks significance in the present population, it is of interest to note in this case that the inverse correlation between clutch-size and population density exists in yet another wild population. It is always possible that this relationship as seen here is a remnant of a once-important adaptation in Song Sparrows that, for purely local reasons on salt marshes, has ceased to have any meaning in a populational sense.

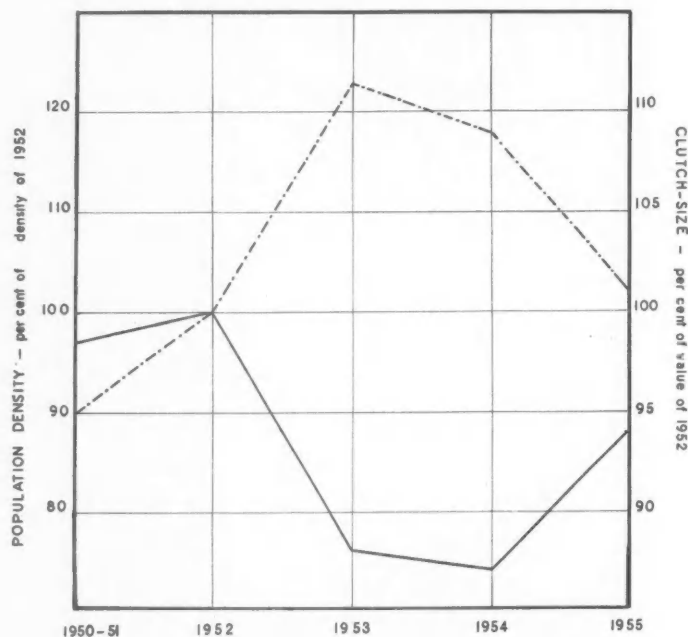
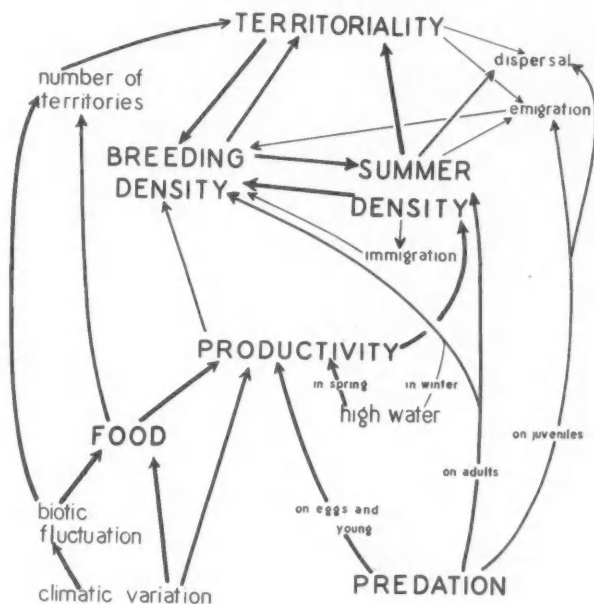


Fig. 3. The relationship between population density (broken line) and clutch-size (solid line) in salt marsh Song Sparrows.

The foregoing considerations in addition to those discussed in relation to territoriality, dispersal, clutch-size, and mortality make possible a generalized graphic representation of factor interactions in the regulation of density in salt marsh Song Sparrows (fig. 4). I am indebted to Ray F. Smith and Frank A. Pitelka for invaluable aid in preparing this diagram. The associations at the top of the diagram are those that occur within the population, primarily as connected with the territorial habit. Those at the bottom show the entrance of factors extrinsic to the population. There is an attempt to classify the relationships into three categories: one of lesser, or intermittent effect, another of consistent but secondary importance, the other of major significance. This is indicated by the width of the arrows. "Biotic fluctuation" and "food" may be termed

the condition of the marsh, or, that which determines the number of useable territories in any year. Dispersing juveniles are easier prey for hawks and owls than are the non-mobile members of the population. The remainder of the relationships have been discussed elsewhere.

Factors Promoting Regulation



Factors Inducing Fluctuation

Fig. 4. Factors influencing population density in salt marsh Song Sparrows.

AGE STRUCTURE

Five factors influence the age structure of a population: natality rates, mortality rates, distance of juvenal dispersal, and rates of immigration and emigration. The size of any of the age classes in the population can be modified by changes in any of these five factors. Accordingly, within a population there can exist varying age structures at different times and places. These variations in time no doubt occur in such fashion as to permit a general picture of the age groupings within the population to be drawn. The material presented below is such a generalization, but it is not intended thus to minimize the importance of the dynamic nature of age structure, in particular the pattern of regular fluctuation associated with the annual cycle. Since my techniques were not sensitive enough to follow such fluctuation, I cannot indicate with any assurance either the

direction or amplitude of change that may have occurred during the time I spent observing these birds.

In this section the foregoing factors in age composition will be examined along with what I call "productivity." Productivity is a function of natality rates and immediate post-natal mortality.

Natality rates.—By natality rate I mean the average number of eggs laid per pair of adult song sparrows per season. This is exactly equivalent to the "fecundity" of Kluijver (1951:79), although my emphasis is on the basic rate of birth rather than on productivity. I use the term "natality" for these birds because of its parallel usage for mammals in being the point in an individual's life when extra-maternal existence begins. Some authors have considered natality in birds to occur at hatching, and there is good embryological justification for this usage, the terms for both mammals and birds then being practically synonymous. But prior to hatching in birds a great deal of mortality occurs from the point of view of the population, and I prefer to consider natality as occurring at laying.

The year 1953 showed the highest natality rate for the three years. This was due chiefly to the favorable environmental conditions that allowed the birds to initiate breeding early in the year so that the average total number of nests per pair was the

Table 3
Natality Rates in Salt Marsh Song Sparrows

Year	Clutch-size	Mean number nests/pair/year	Mean number eggs/pair/year
1952	3.42	2.5	8.5
1953	3.04	3.0	9.1
1954	2.91	2.5	7.5
1955	3.23	2.5	8.0
Mean	3.14	2.6	8.2

highest recorded during the course of observations. This high natality rate was reached in spite of a low figure for average clutch-size. Indeed, as can be seen from table 3, natality is unrelated to annual variation in clutch-size. Natality fluctuates independently of any other aspect of this population. Accordingly, natality rate is of itself an unimportant datum of reference in this population. However, it is an important element in "productivity"; this is discussed later.

Mortality rates.—We may now turn to data on and the calculated rates of mortality for some of the age classes in this population. Field observations were most complete in the younger age groupings of the population, especially the egg and nestling stages. In the later stages there is error resulting from the use of small samples which is not calculable. This is particularly true of the mortality rate in the first year of life as calculated from observations of disappearance of banded young; by this means the total mortality in the first year of life for these birds appears to be about 90 per cent. Yet other evidence (table 10) indicates that this population, in order to remain stable or to increase slightly, depends on a survivorship of juveniles of about 15 to 19 per cent; mortality for the first year would seem to be around 80 to 85 per cent, assuming equivalence between immigration and emigration.

In both cases the mortality rates were empirically arrived at, that is, the disappearance of a color-banded individual was assumed to indicate the death of that individual. It is obvious that this is not always a safe or accurate assumption. However, in view of the restricted nature of the movement of the adult portion of the population, I feel that

the figures on mortality based on disappearance of adults are a closer approach to the truth than are the figures on disappearance of first-year birds. Table 4 presents the crude data that are used in the construction of the life table (table 5). Since the sample sizes I dealt with are small and also because of limitations of time, I have had to com-

Table 4

Field Data Used in Calculating a Life Table for Salt Marsh Song Sparrows

Banding group	Age interval	Number alive at start of interval	Number dying in period
A	0-13 days	403	108
	14-23 days	295	92
	24-365 days	203	185 ¹
	1-2 years	33	14
	2-3 years	19	8
	3-4 years	11	5
B	4-5 years	6	2 ²
	5-6 years	3	2 ³
	6-7 years	1	....

¹Not used in life table. ²Plus one known to be alive. ³One known to be alive.

bine data from two distinct age groups in the total population. These are indicated in table 4 as banding groups "A" and "B." Group A is composed of those individuals that I banded in the nest; the data up to the time of fledging (23 days) are completely reliable, but beyond that time my records contain gaps and there is serious doubt that they reflect an actual situation. Group B consists of birds banded as adults. These individuals were at least one year old when my records on them began. They furnished generally reliable data.

Table 5 presents the life table for adult salt marsh Song Sparrows. The methods used in the construction of this table agree most closely with those used for the "composite life table" as defined by Hickey (1952:8); much of this is implied in the para-

Table 5

A Life Table for Song Sparrows on San Pablo Marsh

Age Interval	Number dying in interval (d_x)	Number alive at start (l_x)	Mortality rate in per cent (q_x)
0-13 days	260	1000	26
14-23 days	247	740	30
24-365 days	393	493	80 ¹
1-2 years	43	100	43
2-3 years	25	57	43
3-4 years	14	32	43 ²
4-5 years	8	18	43 ²
5-6 years	4	10	43 ²
6-7 years	....	6	43 ²

¹Average minimum expected according to table 16. ²Assumed rate.

graph above. The birds under observation were of various relative and absolute ages at the time of banding, and, presumably, lived under different sets of mortality risks. As is true for most life tables based on natural populations, this table has been constructed assuming that all individuals were born at the same time. Additionally, since the study has been a short one and since birds were banded in all years of the study, some of the

individuals are still living. Since these birds are included in the data on which the table is based, it not only presents mortality rates in a hypothetical population but also a maximum set of rates for these hypothetical adults.

The figure of 43 per cent mortality per year for birds older than the age of five months agrees closely with what Nice (1937:168) found to be true for the more mobile, mid-continental, male representatives of this species under "normal" conditions of habitat. Probably the highly sedentary marsh population has a lesser rate of mortality than this, as has been indicated (table 5). At the least it is possible to state that the mortality rates in this population are neither unexpectedly slight nor severe.

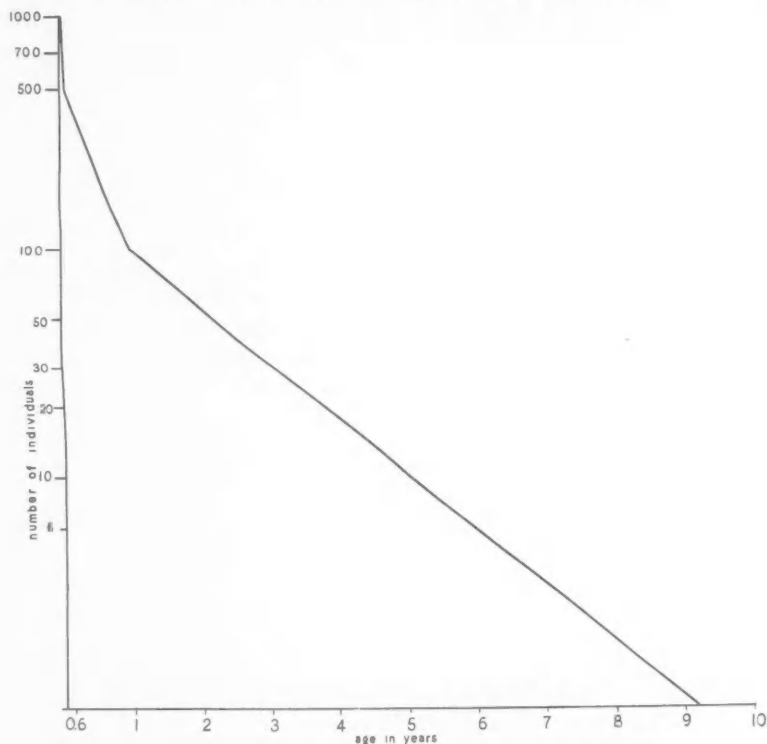


Fig. 5. Survivorship curve for salt marsh Song Sparrows; graphing is semi-logarithmic.

The data describing mortality rates for all the age groups are presented graphically in figure 5. The steep, concave curve describes typically populations that have a large mortality in the youngest age groups, which are abundant. Similar, but steeper, curves have been called "concave J-shaped survivorship lines" and have been thought to be rare among vertebrates (Hickey, 1952:4). However, Song Sparrows in Ohio (Deevey, 1947:298) and the present population appear to be good approaches. Additionally, Sooty Grouse (*Dendragapus obscurus*) in British Columbia (Bendell, 1954), and meadow mice (*Microtus montanus*) in the Sierra Nevada of California (Hoffmann,

MS) probably also show a tendency toward this type of curve, and it may be that it is more common among vertebrates than has heretofore been appreciated. On the other hand it is known (Deevey, *op. cit.*) that completely different kinds of curves, representing different mortality relationships, are characteristic of other vertebrates.

A breakdown of all records of mortality for salt marsh Song Sparrows beyond the age of six months has shown that there is no difference statistically between the numbers of birds dying in the period from August to January and those dying in the period from February to July. Nice (1937:174) also found no difference in mortality rates for these two periods of the year, but Erickson (1938:311) noted a 4 to 1 rate of death in winter over summer in the Wren-tit (*Chamaea fasciata*).

Sibling survivorship.—I have examined the data on survival of young birds to the age of one month. Table 6 compares an observed distribution of sibling pairs or triplets that survived to at least one month following fledging to a calculated distribution. This is that calculated by means of the Poisson distribution and is characteristic of random survivorship.

Table 6
Sibling Survivorship in Salt Marsh Song Sparrows

	0	Number of siblings		
		1	2	3
Observed distribution	16	16	6	0
Random expectation	20	11	5	2

The comparison is intended to indicate a high probability that if a bird lives to be two months old, it will more often than not have a sibling surviving to the same age, and that this situation is not merely the result of chance. However, statistical significance by the chi-square test is reached only at the 10 per cent level. Considering the variability inherent in such relationships and the potential for expressing this in small samples, it would be rash to insist that coordinated survival of sibling pairs is an established fact in the present population. But, basically, all that is being said is that if similar genotypes are inherited by siblings then they stand a similar chance for survival to any age, other conditions being equal.

Clutch-size and survivorship.—Table 7 shows the data relating clutch-size to survival. It deals with survival to the age of three weeks, that is, up to the time of fledging. This is probably the most meaningful time at which to consider the influence of clutch-size on survival, as Lack and Lack (1951) have maintained.

The differences in the rates of fledging, representing survivorship to the age of three weeks, are not different enough statistically to warrant assuming that anything other than chance is involved. Under ordinary circumstances it would seem clear that 2-egg clutches are rather a liability in this population. However, most of these clutches were laid in 1954; this was a year of very low fledging success. Since clutches of all sizes are

Table 7
Clutch-size and Survival in Salt Marsh Song Sparrows¹

Clutch-size	Number of eggs	Number of young fledged	Per cent fledged
2	34	13	38.2
3	180	102	56.8
4	120	68	56.7

¹ Data are from 1952, 1953, and 1954.

about equally effective in fledging young, clutch-size plays only a small role in survival of young birds. Lack (1950:281) found that nestling survival in titmice (*Parus*) was nearly the same from both large and small broods. But in the Common Swift (*Apus apus*) Lack and Lack (1951:517) have shown nestling mortality to be higher in large than in small broods when food was in short supply.

With reference to three-egg and four-egg clutches, the fact that they fledge about the same per cent of the total eggs means also that clutches of four should in time become more common in the population if individual control of clutch-size is inherited. Since three-egg clutches exist at all, and are in fact twice as common as clutches of four, there must be some environmental factor or factors favoring the production of three-egg sets. Or, if any inheritance of a tendency to produce the parental clutch-size exists, it is not so strict that the relationship between clutch-size and the environment is thereby weakened or obscured. This is in accord with the belief that small variation in clutch-size in a population is due to environmental causes that vary year to year, as has been outlined above. Kluijver (1951:74) arrived at the same conclusion following an analysis of differences in sizes of first clutches: "Any individual (hereditary) disposition to lay a clutch of fixed size is not predominating, and adaptation to environmental factors is evidently of great importance."

Table 8
Productivity in Salt Marsh Song Sparrows

Season	Number of nests		Number of fledglings		Productivity	
	Initiated per pair	Successful per pair ¹	Per initiated nesting ²	Per successful nesting ³	A ⁴	B ⁵
1950-51	2.5	0.84	0.82	2.50	2.05	2.27
1952	2.5	1.90	2.35	3.04	5.87	5.64
1953	3.0	2.25	1.74	2.32	5.22	5.23
1954	2.5	1.05	1.12	2.46	2.80	2.64
1955	2.5	1.65	1.48	2.30	3.70	3.79

¹Number of nests x per cent of successful nests. ²A nest in which at least one egg was laid. ³A nest in which at least one fledgling was produced. ⁴Number of fledglings per nest x number of nests initiated. ⁵Number of fledglings per successful nest x number of successful nests.

Productivity.—By productivity I mean the number of fledglings produced per pair of breeding adults per year. Table 8 presents the data on productivity. Productivity is calculated in two ways. That the results of both agree closely for any one year is in part a reflection of the fact that both methods have two common bases: the total number of fledglings and the estimated number of nestings initiated. But the concurrence of the figures on productivity for any one year argues for the basic worth of these means of calculating the number of fledglings per pair per year.

I believe that this estimate of productivity is for salt marsh Song Sparrows a more reasonable one than is the use of the total egg production per pair per season (the

Table 9
Clutch-size, Natality, and Productivity in Salt Marsh Song Sparrows

Year	Clutch-size	Natality ¹	Productivity ²
1952	3.42	8.5	5.87
1953	3.04	9.1	5.22
1954	2.91	7.5	2.80
1955	3.23	8.0	3.70

¹Mean number of eggs/pair/year. ²Mean number of fledglings/pair/season.

"fecundity" of Kluijver, 1951). We have seen earlier that for this population, variation in egg-production is so slight inter- or intra-seasonally that differences in mortality of the very young age groups are basically the determining factors in yearly productivity; differential egg-production does not enter the picture. This is more clearly indicated in table 9, which shows clutch-size and productivity to vary independently of one another.

Actually, Kluijver's (1951:89) "production" is exactly equivalent to productivity as used here. I made the distinction earlier between productivity and "fecundity" because the recent literature (for example Lack, 1952) has used Kluijver's fecundity rate as the major indication of reproductive intensity for the Great Tit. This has been the case because the inverse correlation between fecundity and population density is stronger than that between production and density, although the latter is apparently just as real.

It is likely that with greater variation in clutch-size, as is found in the Great Tit, the use of "fecundity" is an accurate reflection of production of young in a population. This is especially true where there is no great fluctuation in the pre-fledging mortality from year to year, as is perhaps more likely to be true in a hole-nesting species.

The figures on productivity enable a calculation of survivorship in the first year of life to be made; it will be recalled that the empirical data on survival in this age class were deemed unsatisfactory due to difficulty in finding all the surviving birds of any one year subsequent to their dispersal. Table 10 allows another approach; it may be termed a replacement table. The left-hand column lists "corrected productivity," derived by multiplying the yearly productivity per pair by 50 pairs. Since we know from the average annual adult mortality rate that there will be 43 per cent mortality among these 50 pairs in a year, they will require 43 replacements from the crop of young Song

Table 10

A Replacement Table for Salt Marsh Song Sparrows

	Rates of productivity	Survivorship rates in per cent					
		15	16	18	20	25	30
1954	140	21	22	25	28	35	42
Mean	230	35	37	42	46	53	69
1953	260	39	42	47	52	65	78
1952	290	43	46	52	58	72	87

Sparrows they produced. The various survivorship rates in table 10 show, at any intersection, the number of individuals surviving after one year. For example, in 1952 the productivity was 290 young per 50 pairs of adults and in the following year the population had increased by 24 per cent; about 70 young of the 290 had survived, a rate of 24 per cent. In 1953 the productivity was 260 young and the following year's population density was not changed significantly over that of the previous year; the survivorship rate was thus about 17 per cent. In 1955 the population declined by 14 per cent following productivity of 140 young per 100 adults; survivorship must thus have been a little over 20 per cent.

Survivorship in the first year of life for salt marsh Song Sparrows is seen to fall somewhere around 20 per cent per year, if the population is to remain constant, that is, if it is to fluctuate with low amplitude about a mean value. This is close to the rate Nice found for song sparrows in Ohio, but a departure from rates found for species of birds that migrate. von Haartman (1951:47) found a 27 to 30 per cent replacement was necessary for the Pied Flycatcher (*Muscicapa hypoleuca*).

MORTALITY FACTORS

We have seen that there are two distinct groups of song sparrows on the salt marsh with respect to mortality rates. The same division is maintained when the agents of mortality are considered. In the egg and nestling group, which suffers about 50 per cent mortality in a period of a little more than three weeks, the major mortality agents are rodent predators and high tidewater. Subsequent to fledging the expectancy for further life rises until a relatively constant rate of mortality holds effect; this rate is about

Table 11

Egg and Nestling Mortality Among Song Sparrows on San Pablo Marsh

Agency	1950-51 N = 54		1952 N = 107		1953 N = 140		1954 N = 102		1955 N = 101		Total N = 504	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Predation	15	27.7	11	10.2	35	24.8	23	22.5	15	15	99	20.0
High tide water	13	24.0	8	8.5	4	2.8	19	18.6	12	12	56	11.1
Desertion	7	12.9	3	2.8	3	2.1	13	12.8	1	1	27	5.4
Storm	....	....	4	4.2	6	4.3	....	....	13	13	23	4.6
Infertile eggs	3	5.5	3	2.8	6	4.3	5	4.9	4	4	21	4.2
Loss of eggs	....	....	5	4.6	2	1.4	2	1.9	3	3	12	2.4
Embryonic failure	2	3.7	2	1.8	2	1.4	2	1.9	2	2	10	2.0
Cowbird	....	....	....	....	....	....	....	....	5	5	5	1.0
Totals	40	74.0	36	33.5	58	41.2	64	62.7	55	55	253	50.7

43 per cent per year and operates on adults and probably on birds older than 6 to 8 months. The major mortality agents for this age group are, or appear to be, Marsh Hawks and Short-eared Owls; there are doubtless others, but these are notoriously hard to detect and have not been observed in action.

Table 11 lists the major causes of death and their relative importance in several years for the youngest age classes of Song Sparrows. Infertile eggs are included in this list; haploid mortality, that is, death of an unfertilized ovum, is just as effective as the diploid. The birds never replace an infertile egg with a fertile one, and thus the productivity of the clutch is decreased as efficiently as if a predator had removed a nestling. By far the most stable mortality agent is predation. By this I mean chiefly rodent predation. Only in 1952 did mortality due to rodents fall below the 20 per cent level. The next most serious cause of mortality is flooding due to high tidewater; this is of variable, but usually significant, importance. Beyond these major causes of mortality are the lesser factors; although none alone assumes major dimension, in the aggregate they account for more losses than does tidewater. Each mortality agent that appears in table 11 is discussed in turn below.

Predation.—In this category are included all nest losses that clearly were attributable to animals. When a nest that I had been watching was found empty prior to the fledging of the young, and also variously torn and disarranged, I laid the cause to rodent predation. In no instance, however, were rodents actually seen destroying nests but circumstantial evidence was usually strong. One nest was found disarranged, the eggs gone, and in their stead was a fecal pellet of the brown rat (*Rattus norvegicus*), an abundant resident on the marsh. Another nest was found destroyed after rats had found bird seed that I inadvertently had spilled only twenty inches from the nest.

Perhaps of more general significance in establishing rats, and rodents generally, as predators are the details of the drop in population number of the rodents and mammals as a group on the lower marsh in 1952. In that part of the marsh inhabited by Song

Sparrows, rodents were very scarce as indicated by the almost complete absence of cuttings of *Microtus*, fecal pellets of any kind, and nests of *Microtus*, *Rattus*, *Reithrodontomys*, and *Sorex*, which normally are easy to find. Probably the low numbers are to be correlated with the extreme wetness of the marsh that spring due to late and heavy rainfall. Most survivors of the mammal populations appeared to have moved higher on the marsh, to areas devoid of Song Sparrows. The old, high marsh is usually only sparsely inhabited by mammals, but in 1952 they found it suitable for living. They occurred there in numbers about three to five times those recorded in years both earlier and later. In 1952 the mortality in Song Sparrow nests that could be attributed to rodents was the lightest in the period from 1950 to 1954; it was half that recorded on the average (table 11).

An attempt to establish mammals other than *Rattus* as predators is difficult. There is one instance of nest disruption known to have been caused by *Microtus*, but in this case the eggs that were in the nest were not eaten, or even broken; it was the nest cup lining that was taken. Likewise little evidence points to *Reithrodontomys raviventris* as a predator; a discussion of the relationship of *Reithrodontomys* to Song Sparrows may be found in Part I (Johnston, 1956) of this report. Shrews (*Sorex vagrans*) may also enter the picture of predation, since it is possible that these mammals may take nestlings, although again there is no evidence.

High tidewater.—Flooding by the tides accounts for the destruction of 11.8 per cent of all eggs laid in an average year. But this does not show the true importance of tidal floods, for mortality due to them may rise to 24 per cent in some years. The water may float out eggs from the nests or may down nestlings. It appears that occasionally nestlings may be killed by exposure to wetness and cold. The eggs of Song Sparrows can stand immersion in salt water for limited periods of time. On one occasion an egg was floated out of a nest and left stranded in vegetation two inches away from and slightly lower than the nest cup. It remained there for an estimated six hours after which time I found it and replaced it in the nest. A young bird hatched from it two days later at the same time that the rest of the clutch hatched, and all young of this nest were fledged at the same time ten days later. It is probable that mortality from wetness and cold varies with the age of the embryo; generally the younger they are the more susceptible they are to chilling.

Desertion or death of female.—Six and a half per cent of the eggs did not result in fledged young because of the absence of the female parent. The absence was due variously to death or causes perhaps of a psychological nature. Probably most of this egg and nestling mortality is due to death of the attendant female parent, but since it is difficult to determine an individual's death, this cannot be unequivocally maintained. Practically all mortality due to desertion occurs in the egg stage.

Storms.—About $4\frac{1}{2}$ per cent of the total mortality was caused by rainstorms. But, more than half of this mortality occurred in one year only (1955); mortality due to rainstorms is intermittent. Death of young Song Sparrows may be effected in at least two ways and also by combination of both. Parent birds cannot easily find enough food for nestlings when it is raining, for insects in the rain here seek shelter or are killed. And the young birds are themselves occasionally killed by the rainstorms, either through dampness, cold and exposure or by direct physical damage inflicted by driving rain or by being blown from the nest by wind.

Infertility.—A little over four per cent of all eggs were infertile. It is possible that some eggs that stopped early in development are included in the total here. If losses due to infertility and to addling are combined, the per cent loss is 6.1. This is very close to the figure of 5.7 per cent loss to these agencies recorded by Nice (1937:146).

Loss of eggs.—About two per cent of the eggs disappeared from the nest before hatching; in all instances the losses were single eggs from clutches of two or more eggs. Probably such loss is due mainly to eggs being kicked out of the nest by the incubating bird when she flushes hastily from the eggs. Thus, much of this type of loss can be laid to my presence on the marsh, for it is unlikely that many incubating females would flush from the nest hastily were I not present (see Skutch, 1954:544). A part of the loss may be due to sporadic theft by *Reithrodontomys*.

Embryonic death.—About two per cent of the eggs failed to develop completely and died sometime before hatching. Mostly the embryos died at about three to six days of incubation, and therefore when I could check them they were decomposed. Accordingly, it was not possible to determine the cause of death of any of these embryos.

Table 12 shows the relative importance of the three major causes of egg and nestling mortality; 41.8 per cent of mortality occurs in the egg stage and 58.2 in the nestling stage. Considering the fact that there are always more eggs from which losses are drawn than there are young, it is apparent that there is significantly more mortality occurring

Table 12

Relative Influence of the Major Causes of Mortality on the Youngest Age Groups of Song Sparrows

	Eggs		Nestlings	
	Number lost	Per cent of egg mortality	Number lost	Per cent of egg-nestling mortality ¹
Rodent predation	31	48.8	53	34.2
High tidewater	14	21.6	30	19.5
Desertion	19	29.6	7	4.5
Totals	64	100.0	90	58.2

¹ That mortality due to rodent predation, high tidewater, and desertion.

in the nestling stage than in the egg stage. Nice (1937:145) found more mortality occurring in the egg stage, but it seems reasonable to find more deaths among nestlings of altricial birds. Helpless but quiet eggs seem less likely prey items than helpless but squirming or occasionally noisy nestlings.

Rodent predation is significantly a greater cause of mortality in both age groups than the other factors examined. Tidewater causes twice as much mortality in the nestling stage; this is probably a reflection of greater susceptibility of the nestlings to being wetted. As has been mentioned earlier, it takes flood water high enough to float eggs from nests in order to result in the deaths of individuals, but a nestling may be killed merely by being exposed to very wet conditions for half an hour. Probably also of significance is the fact that desertion is a greater cause of mortality in the egg stage; the parent presumably has a stronger attraction to the nestling than to the eggs.

Causes of adult mortality are difficult to deal with. The Marsh Hawk (*Circus cyaneus*) is probably the most important predator on adult Song Sparrows. This hawk is present on the salt marsh throughout the year, varying in number from a breeding population of one pair to a winter high of five to seven individuals. Three times I have found feather remains of Song Sparrows that beyond reasonable doubt were the result of plucking by hawks; this is slight evidence indeed, but no other hawks occur on the marsh. Known takers of small passerines that have been seen in the area are the Sharp-shinned Hawk (*Accipiter striatus*), Peregrine Falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), and Sparrow Hawk (*Falco sparverius*). These hawks have been

seen only to pass through, or over, the marsh. Doubtless they do hunt on the marsh to some extent, but they apparently represent only a small agency of mortality to Song Sparrows.

Another predator on adult Song Sparrows is the Short-eared Owl (*Asio flammeus*). This bird is present on the marsh from August to April. The average number occurring on the 100-acre plot is five or six; seven or eight probably are present in December and January. Short-eared Owls are known to prey on Song Sparrows since four sparrow skulls appeared in cast pellets of the owls. Four hundred and ninety-one pellets were examined to find the four skulls and it would seem, therefore, that the owl is not a major factor in Song Sparrow mortality.

At the time of the extremely high winter high tides, the Marsh Hawks and Short-eared Owls both hunt extensively in daylight along the *Grindelia* rows that mark the courses of the tidal sloughs. At the time of the highest tides the topmost limbs of the *Grindelia* plants are the only marsh vegetation left exposed above water. It is in this and on floating wood and *Spartina* flotsam that Song Sparrows perch when the water is high. Thus, with other members of the marsh fauna, Song Sparrows are exposed to heavy predation pressure by these hawks and owls at this time of highest daylight tides.

DISCUSSION AND CONCLUSIONS

The means by which the races of the Song Sparrow on San Francisco Bay salt marshes maintain themselves as morphologic entities has been one of the focal points of the present study, as it was also of Marshall's (1948) intensive ecological survey. Additionally, Grinnell (1913:194), Huxley (1942:272), Miller (1942, 1947), Mayr (1942:249) and von Haartman (1949:83) have all discussed the bay marsh Song Sparrows and their existences as morphologic and ecologic entities. Grinnell and Huxley emphasized the role of ecological preferences or habitat selection in promoting isolation. The remainder, including Marshall, have thought that restriction of movement of individual birds resulting in semi-isolation of the several populations involved, or in isolation by distance (Wright, 1940:245), could account for the ecologic and morphologic diversity now evident. The action of selective forces has always been assumed, and indeed this is essential if divergence of populations is to be accomplished.

These hypotheses will be examined in the light of the data and conclusions of the present study in order to see if they are adequate and whether or not other or alternative explanations seem likely.

Isolation.—Since we are concerned with populations of one species, we have to do not with full isolation but with degrees of partial isolation. There seems to be little question that the short distances involved in the stretches of uninhabitable land between populations of marsh and upland Song Sparrows actually comprise real barriers, hindering the birds in moving easily from one place to the other. The main reason that these short distances mean anything in the evolutionary process in Song Sparrows is that this species is, by and large, not inclined to move.

We have seen that adult members of the population living on San Pablo salt marsh comprise the most sedentary bird population on record. The data presented make inescapable the conclusion that no exchange of members of adjacent populations is going to occur if adult birds such as these make up the populations; the adult Song Sparrows of San Pablo marsh are almost completely isolated from other adult Song Sparrows.

Likewise we may consider the juvenal portion of the salt marsh population to be the most sedentary juvenal segment of a bird population ever found. This is a conclusion based on the extremely short distances that the young birds travel as a group. As individuals, however, we have seen that some of them move great distances and that actually

these few may well be endowed genetically with a tendency to disperse to considerable distances. It is these individuals that move half a mile or more that serve as links between populations and that in so doing break down slightly the isolation by distance that otherwise separates these Song Sparrow populations. The emphasis here, however, should be on the very high percentage of the juvenal birds that move only slightly; these individuals promote effective spatial isolation.

Selection.—The effects of selection and immigration tend to cancel one another in a given population; since immigration is a negative measure of the degree of isolation obtaining on a population, it is apparent that selection and isolation work together to produce any local differentiation. It has not been possible to assess the force of selection for any particular characteristic of the marsh population. We can see, however, that selection must prevail in order that the semi-isolated marsh population may diverge from upland groups morphologically and physiologically as it has done and is apparently continuing to do.

Evidence in this regard may be found in the degree of difference between adjacent populations of Song Sparrows called *M. m. samuelis* and *M. m. pusillula*. Once the land lying between the Stege and San Pablo salt marshes, to the south and north, respectively, of the city of Richmond, also was a salt marsh (Marshall, 1948:208). There are extant only a few remnants of what was once continuous salt marsh surrounding the Richmond headland; the fractionation of this marsh took place about fifty years ago. Today there are no Song Sparrows living in the area between Stege and San Pablo marsh, but it may be assumed that in all probability fifty years ago individuals representing distal populations of what we now call *samuelis* and *pusillula* were here connected.

Therefore, from a situation of virtual identity, the Stege examples of *pusillula* and the San Pablo examples of *samuelis* have diverged in half a century so that they now are visibly distinct. The differentiation is not marked but it has proceeded in several directions (Marshall, 1948:234–246). One of the strongest characteristics of the south bay populations, that of yellow-colored belly feathers, now occurs in about 25 per cent of the birds at Stege but in only two per cent of the birds on San Pablo marsh.

Also it seems clear that there is selection favoring early breeding on the marsh. In this manner there has been produced the distinctly early breeding populations found on the bay marshes. Late-breeding individuals are yet today at a reproductive disadvantage and will tend to leave fewer offspring than their salt marsh cohorts. This argument supposes that earliness or lateness of inception of breeding is inherited.

Population density.—Density and population pressure will influence the amount and direction of interchange of individuals between populations. In this sense population density has a modifying effect on isolating mechanisms. Movements influenced by density are from the areas of high density and pressure to the areas of low density and pressure. Therefore, a high density on San Pablo marsh would have the effect of tending to turn the tide of movement to areas away from the marsh, providing that these outlying areas are lower in population density than the marsh. Other things being equal, high density of population on the marsh is favored by a high yearly productivity of young; this is favored by early breeding and low egg and nestling mortality.

Habitat selection.—To a certain extent we know that Song Sparrows do select particular habitats over others that they could conceivably live in. Whenever they select a habitat similar to the one in which they were raised, movement tends to be severely restricted. Marshall (1948:249) tells of the shift in numbers of Song Sparrows in the Contra Costa County riparian environments. In these areas, numbers of Song Sparrows increase, presumably by addition of individuals from North-bay upland populations that move out of their breeding habitats when the creeks in those areas go dry in the

summer. None of these upland individuals has ever been found in brackish or salt water marshes that lie many miles closer to where the birds started to move. Additionally, of the 2015 skins of the Song Sparrow Marshall looked at, only two were obviously from groups breeding in vegetation types other than the ones in which they were shot.

My data on movements show but one individual, not a bird of the salt marsh, shifting its habitat: a bird reared in a typical riparian situation along Wildcat Creek, but only one-quarter mile from the marsh, which was in view, was found to have dispersed a distance of 660 meters into a fairly typical *Salicornia* habitat. There is no other instance of a shift in habitat by these birds. In those areas where the creeks come through San Pablo marsh, the two vegetation types of willow-riparian and *Salicornia*-salt marsh are juxtaposed. Not much of the original situation is left uncomplicated by exotic plants, but generally the two habitats are in plain view of one another. It is from such areas that one would expect birds to make the shift, as indeed one did. Since the incidence of such shifts is very low, this situation helps to restrict interpopulational exchange.

In the presence of natural selection, it is thus concluded that limited movement, high population density, and habitat selection cooperate to maintain this population as a distinct, recognizable entity.

SUMMARY

This paper is the second part of a report on the population ecology of salt marsh Song Sparrows (for Part I, see Condor, 58, 1956:24-44).

On the study plot, Song Sparrows in a year of medium density existed at about one pair per acre. Along the sloughs, where the birds spend all their time, the density runs from 6 to 10 pairs per acre, depending on the absolute number of birds on the marsh and the complexity of the vegetation available to them. Shifts in density were minor; the largest was a 24 per cent increase in 1953 over 1952. Density was found to vary directly as the preceding year's productivity.

Natality rates varied from 7.5 to 9.1 total eggs per pair per season; these figures are not correlated with clutch-size or productivity. Mortality rates vary from 56 per cent in the first three weeks, to about 80 to 85 per cent in the period of the third to the fifty-second week, to 43 per cent per year for adult birds. A life table is presented. The chances are better than even that if a bird survives to the age of one month it will have at least one sibling also surviving to that age. Clutch-size is not related to survivorship. Productivity varied from 2.0 to 5.8 fledglings per pair per season.

Mortality factors for Song Sparrows include rodent predation, high tide water, death of or desertion by the adults, infertility and embryonic death, and storms. Predation, tidal floods, and desertion cause about 80 per cent of the total mortality to eggs and nestlings. Marsh Hawks and Short-eared Owls are thought to be the most important predators on adult Song Sparrows.

Those aspects of the population structure that favor a strong isolation, a high density of population, and the existence of habitat selection by the birds all favor the maintenance of the integrity and distinctness of the population of Song Sparrows on San Pablo salt marsh.

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BREEDING OF THE SNOWY OWL IN SOUTHEASTERN BAFFIN ISLAND

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The Snowy Owl (*Nyctea scandiaca*) bred in considerable numbers in the vicinity of the Royal Canadian Air Force Base near the head of Frobisher Bay, southeastern Baffin Island, in the summer of 1953. We did not often see this bird at the Base proper, but in the high land to the east, northeast, and north we saw or heard it frequently. We were attacked so fiercely by one pair that we came to look upon all owls with misgivings; however, no owl attacked wholly without warning. Pairs whose nests we approached hooted at us either from a distant hilltop or while flying from one lookout post to another; they usually did not attack until we were within 100 yards of the nest or young. When attacking, the birds usually flew low rather than diving from high in air. In ordinary flight the wing-beats were exceedingly deep, the head and front of the body rising perceptibly with the downstroke and sinking with the upstroke.

The owls' cries were a simple *whoooooo*; a terse *who-who*; a deliberate *who, who, who, whooooo*, given only by the male, the last note wonderfully rich and full; a thin, high squeal, usually given by the female, and invariably accompanied by "rocking" distraction behavior; a barking *ha, how, howk*, or *quock*, which sometimes became a volley of whooping similar to that of a Barred Owl (*Strix varia*); and a raucous *ca-ca-oh*, given only by the female, which reminded us of the crowing of a rooster. Males often hooted, with throats puffed out, from a favorite perch near the nest. The section dealing with the Snowy Owl's voice in "The Handbook of British Birds" (Witherby, 1948:310) is wholly inadequate. In this work the Snowy Owl is represented as being a rather silent bird.

Within a mile or so of the Base there were four nests, one of which we never examined, for it was just west of the Sylvia Grinnell River, which we had no means of crossing. North and northeast of the Base, within a radius of six or seven miles, were several more nests, four of which we found. Most of this high interior was "desert tundra." Soper (1940:16) calls the Snowy Owl a "widely dispersed" inhabitant of this sort of country.

The areas defended by pairs of owls seemed to be roughly circular and about one mile each in diameter. We often walked through certain of these areas, and, while passing along the edge of one defended area, we must occasionally have been on the edge of another also, for one pair of owls hooted behind us and another in front. Several of the territories fitted closely together. Never, however, were we attacked by more than two owls in any one place. In late June and early July, male owls seemed to do all the hunting and also to be more aggressive than females in defending territories. Thereafter, possibly because we had shot at some of the males, the females seemed to be the more pugnacious.

Male owls were white whereas females were gray. The grayness of the females was dirtiness to some extent, but their plumage was more heavily marked than that of the males. Females became dirtier as the season advanced. All the males we observed were, so far as we could tell, monogamous. In the Owl River region, inland from Padle Fjord and well north of Frobisher Bay, members of the Baird Expedition found one bigamous male as well as "at least four" monogamous males in the summer of 1953 (Watson, 1953:246).

Near the mouth of the Jordan River, 16 miles west of the Base, we made observations at two additional owl nests. At one of these nests we saw only one adult owl, almost certainly the male, since it was very white. We were in the vicinity of this nest for several hours, and the owl hooted and flew at us repeatedly, but as the mate did not appear, we concluded that she had been killed (see nest 10).

The abundance of owls at the head of Frobisher Bay was made the more notable because we failed to find them on Hill Island, Bishop Island, and other islands west and southwest of the Base, across the bay. We found pellets on Hill Island on July 18, but we did not see any owls there. We did not see owls in the Wordie Bay district on August 8, nor did we see a hare, ptarmigan or lemming, and we saw only a few lemming droppings. Men stationed there had seen no owls, but they had seen arctic foxes (*Alopex lagopus*). At least one pair of owls nested along the southeastern shore of Lake Amadjuak (latitude $64^{\circ} 38' \text{N.}$, longitude $70^{\circ} 28' \text{W.}$). On August 8 we saw two adults there, perched on hummocks not far apart. On August 15 we saw two adults and two young in the same area, the latter flying strongly. At Cape Dorchester, near a lake at latitude $65^{\circ} 20' \text{N.}$, longitude $77^{\circ} 10' \text{W.}$, August 11, we saw an adult owl but heard no hooting and found no young birds.

Apparently the breeding population of owls near the Base in 1953 was exceptionally dense. This dense population may have been due to two factors: the relative absence of enemies, and the abundance of food supply. It is true that the Rough-legged Hawk (*Buteo lagopus*), Peregrine (*Falco peregrinus*), Glaucous Gull (*Larus hyperboreus*), and Herring Gull (*L. argentatus*), all of which prey on lemmings, were present in sufficient numbers to furnish the owls some competition. However, there were no jaegers, and the absence of these predatory gulls surely favored the owls. Bailey (1948:265) reports the killing of an adult owl by two Pomarine Jaegers (*Stercorarius pomarinus*) in Alaska. The lemming-eating habits of jaegers are well known (see Pitelka, Tomich, and Treichel, 1955:87). Where there are many lemmings and no jaegers, the owl's chances for surviving and increasing are good. Also there were no foxes, and weasels (*Mustela erminea*) were extremely rare. Ravens (*Corvus corax*), which are normally lemming eaters, fed regularly at a dump near the Base and were not observed foraging at or near any owl's nest.

Both the collared lemming (*Dicrostonyx groenlandicus*) and brown lemming (*Lemmus trimucronatus*) were abundant. We saw burrows, old nests, heaps of droppings in the wet snow, flattened nests on the moss, piles of dry grass neatly sectioned for food, and entrances to fresh burrows in the turf. Many times daily we saw lemmings running ahead of us or heard them splashing along wet runways under rocks. V. C. Wynne-Edwards, who was at the Base from July 11 to 24, considered the lemmings "not really abundant." Nevertheless we continued to feel that their presence plus the complete absence of jaegers, foxes, and gyrfalcons, and the great rarity of weasels furnished the most plausible explanation for the local abundance of owls.

OBSERVATIONS AT NESTS

Nest 1.—This nest was found on June 11 about a mile east of the Base on a mossy eminence on a steep slope about 400 feet above the "HBC" River. The nest-site had an eastern exposure, and little snow was left near it. Above us the two owls circled, snapping their bills and hooting. The nest contained nine eggs, one almost hatched. On June 16, there were four young and five eggs. The largest chick, between five and six days old, was becoming gray; the other chicks were pure white. Bent's statement (1938:363) that chicks are white "probably for the first eight or ten days" is apparently in error. Even in the six-day-old chick the incoming dark gray plumage shows clearly through the white natal down. The chicks chirped and whistled. They were dirty about the face from being fed. The smallest tried to crawl under its fellows. Near the chicks lay six lemmings, and the whole area was strewn with feathers of adult owls. Not far away, on another eminence, were quantities of owl feathers, droppings and pellets.

On June 22 the nest held seven young and two eggs, one pipped. The largest chick, though very gray and able to stand, preferred to lie prone, with eyes half closed. Its facial feathers were dark gray, almost black. About the young owls lay 10 lemmings. No other prey remains were in evidence.

On June 25 the last egg was hatching. Several of the chicks were large and gray. The sun was out and the wind gentle, and most of the chicks were panting heavily (maximum temperature: 51.1°F.) (Bailey, 1926:126). A need for keeping cool may be one of the reasons for the scattering of the young from the nest about the time they become wholly gray. On the nest's rim lay 11 lemmings, but there were no other prey remains.

The last egg in this nest hatched on June 25. Some authors report an incubation period of 30 to 38 days (Pleske, 1928:166; Murie, 1929:8; Sutton, 1932:209; Brandt, 1943:420). The egg-laying period at nest 1 was probably at least 18 days; hence the first egg there must have been laid on May 8 or earlier. The hatching period was about 15 days. The average period between hatchings of the nine chicks was about 40 hours. Pleske (*loc. cit.*) reports a period of 41 hours between hatchings of seven chicks.

We last visited the nest on July 10 and found five chicks, none of them in the nest. The smallest was at nest level, about two feet from the rim. Unlike the others it stood high, peeped continuously, and moved its head about as if watching for the return of a parent. The next largest was a few feet downslope, crouched in the moss. The three largest were scattered widely; the largest was farthest from the nest, being about 30 yards away. The old birds were fiercer than they had been. After banding the young, we fed a lemming to the smallest. The nest bottom was thickly carpeted with lemming remains and soggy owl feathers.

We do not know how many of the brood at nest 1 survived. Murie (1929:9) reports a "high mortality among the young. Most of the broods numbering 7 or 8 were eventually reduced to 4 or 5, while some were still further decimated." Gross (1947:595) says: "Ordinarily the mortality is great, with only two or three of the owlets reaching maturity." Brandt (1943:421) suggests that older chicks may eat the younger.

Nest 2.—This nest was about one mile north of nest 1 on a huge rock in the high, barren interior. The nest rock was not the highest point in the vicinity, nor was the nest on the highest part of the rock. Murie (1929:3), discussing Alaskan nests, reports that they "were seldom . . . on the highest elevations." On June 17 this nest contained seven chicks and two eggs. The largest chick was gray all over, the three next largest were partly gray, and the three smallest were pure white. On the rim of the nest were two lemmings. The parent owls were so fierce that we dubbed them "the vicious pair."

There were six chicks in the nest on June 24, and three large gray ones prone on the rock close by. The male parent seemed to be the fiercer. With an unexpected swoop, he pulled hair with his talons (neither of us wore a hat); then he circled quickly and struck, causing a considerable flow of blood. This convinced us that the owls could be dangerous so we covered our heads. Before we left we had been hit several times, usually on the head, sometimes on the shoulder or back, and more often by the male than by the female.

On July 4 six chicks were scattered over the nest rock or at its base, all lying prone, an attitude probably indicating a well-fed condition. We could not find the other three, and we suspected that they were no longer alive. The parents were very aggressive in their attacks on us. The young were a curious mixture of docility and animosity. They refused to beat their wings, bite, or claw. We could not force any of them to stand up, yet even the smallest popped its beak when handled. Despite their large size, they flopped down, as if unable to move, no matter how or where we placed them.

The five young were widely scattered on July 9, although three were still on or at the base of the nest rock. The mother owl attacked repeatedly, often giving her queer *ca-ca-oh* cry. Having found four of the young, we set out to find the fifth by walking away from the nest rock in various directions. If the parent owls attacked less and less frequently, we assumed we were not going in the right direction. Finally, several rods out on the tundra, we found our "chick"—a large, handsome bird, lying prone on the moss and wholly unable to fly, but it was white of face and powerful of foot. The white-barred scapulars of this bird were obviously not of the first winter plumage (fig. 1). Just before we found this chick, the female parent attacked (fig. 2) immediately after an attack by the male, taking us by surprise and inflicting a long scalp wound despite the head-covering of a tough coat. We banded the brood.

As late as July 26 we saw both of these "vicious owls" and at least one of their young. By this time the female parent had become very dirty.

Nest 3.—This nest was on a low ridge just west of the mouth of the Sylvia Grinnell River. We

found it on June 18. As we were climbing a gravelly slope that day, we saw a very white male owl flying toward us. The bird did not swerve in the slightest and passed low overhead. Its eyes were narrowed to slits. From its claws, tucked up under its tail, swung a lemming. It crossed the river, making for the nest ridge. We saw the nest long before the owl reached it, for another owl, a much grayer bird, was standing there. The male alighted beside his mate and presently the female flew off with something dark in her claws, probably the lemming. Carrying this burden to a higher ridge a few rods away, she alighted. The male followed closely and copulation took place. The male now flew to one side and alighted. The female lingered in a crouching position, with tail raised, then flew back to the nest. Murie (1929:6-7) describes behavior of this sort. Watson (1953:246) reports "coition, hunting, and tearing up of prey" among displacement activities frequently observed by himself and others.



Fig. 1. Young Snowy Owl, well developed but still unable to fly, several rods from nest 2. The white wing, tail, and facial feathers, but not the barred scapulars, are of the incoming first winter plumage. Photographed near the head of Frobisher Bay, Baffin Island, July 9, 1953.

On June 30 we saw the brooding female on the nest. On several occasions thereafter we saw adult owls in the vicinity and they probably reared several young. On July 15 we saw two adult owls several hundred yards upriver from the nest. We never visited the nest proper because we could not cross the river.

Nest 4.—We found this nest on June 19, on a high slope just west of Quarry River, about a mile northwest of the Base. It held four young and five eggs. We found the nest while looking for a Rough-legged Hawk nest on a cliff just east of the river. The screaming of the hawks attracted a very white male owl, which flew up and down the valley. Hardly had we noted this male owl when we saw the gray female, motionless on a distant hummock. The male flew toward his mate; she squatted and copulation took place. The owls' nest was only a rod or so from the spot where this union took place. The owl nest and the hawk nest, although several hundred yards apart, were in plain sight of each other. The owls' nest was on a slight eminence well below the highest part of the ridge. A knob nearby was littered with owl feathers, droppings, pellets, and lemming bones. The grass here was luxuriant, probably because of the highly nitrogenous droppings of the owls.

The old owls were not very fierce. While we were on our knees at the nest, they perched close by or flew in narrow circles about us, popping their beaks. Occasionally one drifted out over the valley. If it flew too close to the Rough-leg eyrie, down came a hawk, screaming wildly. Twice we saw a Rough-leg make a direct hit hard enough to cause the owl to throw its feet forward, turn its head, and pause in midair, while its assailant, also staggered, shook itself vigorously before shooting upward for another attack. The owls and hawks probably were at peace with each other most of the time, but whenever we visited the owl nest the owls invaded the hawks' territory.



Fig. 2. Female Snowy Owl attacking. Photographed at nest 2, near head of Frobisher Bay, Baffin Island, July 4, 1953.

On June 21 the nest held six chicks and three eggs (fig. 3), one hatching. The four largest chicks' eyes were open, but slitlike, the irides being pale grayish or greenish yellow. The eyes of the two youngest chicks seemed to be sealed shut. At the edge of the nest was the posterior half of a lemming.

On June 23 we saw the female owl fly to this nest. On alighting she promptly squatted, covering the chicks and eggs. The day was gray and disagreeable (maximum temperature, 40.8°F., minimum 32.2°). The snow, melting as it fell, was in effect cold, hard rain.

On June 26 two eggs were still unhatched. The male parent dived at us for a time, then became quiet. The female, a remarkably gentle bird, alighted about 70 paces from us, put her head down, puffed out her plumage, half spread her wings and tail, and rocked slowly from side to side.

Six chicks were in the nest on July 11, and we found no others in the vicinity. One was too small for banding, so we banded only five.

On July 15 we found three of the banded young, unable to fly, in a group 81 paces upslope from the nest. We could not find the rest of the brood. The parent owls, although not far away, did not attack. On August 6, an unbanded young owl, barely able to fly, was captured not far from the nest-site.

Nest 5.—This nest was on the steep, east bank of Quarry River, about two miles north of nest 4. It was on a narrow rocky outcrop 150 feet above the water, but below the top of the rise. On June 21 it contained six young and four eggs. A few feet from the nest, in a much grassier spot at a slightly lower elevation, was another basin carpeted deeply with lemming remains. This was evidently the site of a previous nest.

The male owl, having failed to drive us off with swooping, hooting, and bill-popping, fluttered past us downslope, alighted in a sort of heap, and, with head low and wings flopping, uttered high, thin squeals. Above us sounded more squeals, then a weird squawk. Looking up, we saw the female, with feathers puffed out, wallowing in the snow. The drift was so slippery that the great bird slid a yard or more downward. Surprised, she stood upright, glared at us, and resumed her wing-flopping and wallowing. The male was exceedingly white; in the bright sunlight he looked almost pink.

On July 3, the nest held seven young and it looked wet and neglected due to bad weather. The male parent, though clean and fit looking, did not attack; instead, he wallowed and squealed in the manner of the female. The smallest two chicks looked half starved.

On July 11, the nest held five young, four of which we banded. The smallest bird looked sick. Under the skin of its side and belly was a great air-pocket. The male parent was more pugnacious than he had been on July 3. Several times he wallowed and squealed at close range. Once, after gliding down the opposite bank of the river and flying slowly toward us, he alighted within an incredibly short distance, bowed low, and rocked from side to side. We threw pebbles at him. He looked at us quizzically but did not wince when the pebbles struck near him.



Fig. 3. Snowy Owl nest 4. The three eggs are hardly distinguishable from the six young. The scattering of adult owl feathers made the nest visible from afar. Photographed June 21, 1953, near head of Frobisher Bay, Baffin Island.

Nest 6.—This nest was on the top of a small hill one mile northeast of nest 2, not far from the junction of the "HBC" River and a swift tributary. It was surrounded by a stand of lush grass about a foot high. On June 24, it contained six eggs and three young. On the rim were six lemmings. We found the nest by hearing hooting ahead of us, seeing first the white male alighting, then the female, a much grayer bird, as she left the nest hill. As we approached, not quite sure where the nest was, the male attacked. Eventually, to protect ourselves, we shot twice at the male owl, taking care not to hit him.

On July 6 the nest held seven chicks and one egg which was hatching. The male flew at us several times without striking, but he was so fierce that we shot at him again. The female continued to be shy. She watched from a distant hilltop, but she did not attack.

We last visited the nest July 9, finding five chicks, four of which we banded. The two smallest tried repeatedly to swallow our fingers.

Nest 7.—This was on a big, sprawling rock topping a low gravelly hill near the "HBC" River, about two miles northeast of nest 6. On July 6 there were six, good-sized, gray young and one egg. The egg probably never hatched, for on our final visit, July 9, no member of the brood was obviously much younger than the rest. We banded the six young.

Nest 8.—This nest was in a sort of basin in a rock well below the crest of a ridge. It was among

high hills and ridges northeast of the Base, two miles north of nest 2. On July 9, three good-sized chicks were in it and a still larger one was about 20 feet away. We collected the adult male, the only adult owl we took all summer. There was no brood patch. The plumage was almost immaculate, beautifully clean, and quite unworn despite the late date. On a ridge about 200 yards from the nest we found pellets, feathers, and a slightly broken owl egg, but no nest-basin of any sort.

We last visited this nest on July 11. When we arrived no adult owl was there, but presently the female flew in with a lemming in her claws. She came straight for us, barking hoarsely. We banded three chicks, but the fourth was so weak we decided not to band it. Our killing of the male parent may have been the direct cause of the starvation of the youngest chick.

Nest 9.—This nest was discovered by V. C. Wynne-Edwards on July 13 when he found four young scattered in the immediate vicinity. The nest was just west of the mouth of the Jordan River, along the crest of the bold eastern front of Silliman's Fossil Mount, a crumbling, plateau-like mass of Ordovician limestone flanked to north and south by higher land. The parent owls did not attack. The male, a very white bird, alighted on the ground, lifted his wings, and rocked from side to side.

We visited the nest on July 18, finding it empty. An egg, with a small hole in its side, lay about two yards away. The adult owls hooted but did not attack. The male alighted on a big rock just above a cliff on which Peregrines were nesting. A Peregrine attacked fiercely, towering and plunging, hitting so hard that the owl ducked and dodged. The owl finally rose in clumsy counterattack and threw its feet up as the falcon stooped. Nicholson (1930:309) reports that an owl, set upon by Parasitic Jaegers (*Stercorarius parasiticus*), shielded itself by "thrusting its wings forward and flapping them."

The young owls must have been scattered widely. We found one of them, a large, white-faced bird, several rods north of the nest, lying prone near a rock, its plumage wet from recent rain. It was very savage and popped its beak, struck out with its feet, and beat its wings when lifted from the ground for banding. It probably would have been flying strongly within a day or so.

Nest 10.—This nest was near the mouth of Jordan River, at the end of a low, rocky ridge rising from grassy tundra, about a mile northeast of nest 9. On July 19 it contained two large gray chicks which were so well developed that much of the white natal down had worn off, yet the facial plumage was dark, wholly without white, and the remiges and rectrices were mere stubs. We failed to find any more young near the nest. We suspected that only the male parent was alive, for we were in the vicinity for several hours and saw one very white owl repeatedly. We were never attacked by more than this one bird. We banded the two chicks.

It is to be noted that the chicks, although large, were not white-faced. According to our experience at several nests, chicks do not become white-faced until after leaving the nest. The highly interesting plate 33 in Pleske (1928) probably is misleading, for here a white-faced bird is shown *in the nest*. The artist did not make this drawing direct from life. He based it on specimens, and we feel sure that the white-faced bird shown, admittedly part of the brood, was collected at some distance from the nest proper.

Other probable nestings.—On July 24, we learned that we had missed a nest along "HBC" River not far from nests 1 and 2. Above a steep slope near a narrows and low cataract, we noted ahead of us a flashing of white and saw a young owl practicing for flight. Several times it rose high enough for us to see its feet and tail, but it never flew forward and we were not sure that it even left the ground. Its feet seemed to clutch the grass. Suddenly we realized that there were several young owls. Running forward, we found five owls within a radius of about 20 feet. Two of the youngest sank to the ground, inert. The oldest flew, but never for more than a few yards at a stretch; another flopped along, only occasionally getting both feet off the ground at once; the third hobbled and flopped, crossed a brook, shoved through the grass, and finally jumped into a pool where, with wings outspread, it floated. Caught at last, this young one popped its bill and struck out with its feet, but it soon became docile. Its plumage was remarkably waterproof. The oldest was the only one of the five which did not quiet down on being stroked. To our surprise, we were not attacked by the old owls. The female finally appeared, but did not lunge at us. The oldest chick was white around the eyes. The rest of the brood were darker, the contrast between the firm white feathers of the face and the gray down of the head and chest being very sharp. We banded all five.

On July 28, we found three of these birds together not far from the spot at which we had banded them. Two could not fly, but one which we stood on a rock and photographed flew about ten feet.

That same day we walked through an area defended by a pair of owls we had seen only infrequently. This was in high country several miles northeast of the Base. We saw a white owl flying low overhead, carrying a lemming in its feet. It alighted at the base of a massive dome of rock, nibbled at its prey, and flew on. As it rounded the dome a gray owl appeared, flying toward it. The two birds swung gracefully upward as they met, and the white bird passed the lemming from its claws directly to the claws of the gray bird. The white owl now alighted on a rock, while the gray one flew behind the dome. Soon the gray one reappeared and the two birds flew for a distance, then alighted on rocks several hundred yards apart.

On August 4, several miles east of Tarr Inlet, adult owls hooted at us several times. Two young owls, both flying well, rose together from a slope near a wide marsh. This area was far east of any of the defended areas we had visited earlier in the season.

From August 1 to 18 we heard the squealing of young owls daily. Broods were scattered far and wide by this time, and the old birds were apt to appear anywhere—even close to the Base. An unbanded young owl, captured August 6 near nest 4 was barely able to fly. From that date on, young birds seemed to be flying strongly and were difficult to approach. As late as August 18 we saw sooty-chested, white-faced, white-bellied young. Birds of this description flew strongly, but their only cry, a shrill squeal, led us to suspect that they were still being fed.

We did not collect any of these sooty-chested young birds, so do not know how the molt was progressing. Bent (1938:363) states that the white body feathers of the first winter plumage push through the gray down, finally concealing it. In our opinion much of the dark gray plumage is actually replaced, but specimens in critical stages should be carefully examined.

Observations from mid-July on convinced us that although broods may scatter temporarily about the time they leave the nest, they do not disband. Having reconvened, the young move about together until they have learned to fly. In the course of the long fledging period of "51-57 days" (Witherby, 1948:310), there is a highly interesting development-differential. The oldest chick is about two days ahead of the next oldest, the youngest is about two days behind the next oldest, and so on. The oldest leaves the nest first and travels a considerable distance aloft while its siblings, one by one, also desert the nest. Being the largest, this oldest bird may consume the most food, but by the same token it learns to fly first and thus is on its own in advance of the others. Statements to the effect that the hatching period is so protracted that the oldest young is "fledged" by the time the youngest is hatching (Collett in Bent, 1938:362) are, of course, very misleading. The oldest of the brood may be large enough to leave the nest by the time the youngest hatches, but weeks will pass before it is truly fledged.

NEST SUCCESS

Table 1 admittedly is not very satisfactory. Nest 3 we never visited. Nest 11 we did not find. Nests 8, 9, and 10 almost certainly held more than four, five, and two eggs, respectively. Clutches in nests 1, 2, 4, 5, and 6 were considered to be complete; the average clutch size for these five nests was 9.2 eggs. How many young fledged from these five nests is not known. We know that at least 69 eggs were laid in 11 nests, and that in these nests 62 chicks hatched. We banded 40 chicks, a significant statement, for chicks large enough to band properly have passed a critical stage in their lives. We obtained no evidence that parent owls killed sickly or half-starved chicks, or that older chicks ate younger ones. At no nest did we find the slightest evidence of molestation by a predator. Some scattered chicks we probably failed to find.

No nest of the nine that we studied was wholly unsuccessful. We believe that most of the young owls banded by us fledged. We are reasonably sure that of all the adult owls near the Base only two were killed (one by us, one by an Eskimo).

To the best of our knowledge the owl population subsisted wholly on lemmings. We examined nests repeatedly for remains of passerines, ptarmigan, or hares. The only ptarmigan we recorded during the summer was the Rock Ptarmigan (*Lagopus mutus*). This species was exceedingly rare near the Base, although we frequently found remains of winter-killed individuals. Some of these may have been killed by owls. We saw the

arctic hare (*Lepus arcticus*) occasionally in rough country between the Hudson's Bay Company post and Tarr Inlet, but it was not at all common.

Table 1
Data Concerning Snowy Owl Nestings on Baffin Island in 1953

Nest number	Date found	Contents on that date	Estimated date for first egg	Minimum clutch size	No. eggs known to have hatched	No. eggs believed not to have hatched	Number young banded	Minimum no. young believed to have fledged
1	June 11	9 eggs	May 10	9	9	0	5	5
2	June 17	2 eggs, 7 young	May 4	9	9	0	5	5
3	June 18	?	?	?	?	?	?	?
4	June 19	5 eggs, 4 young	May 11	9	7	2	5	5
5	June 21	4 eggs, 6 young	May 10	10	7	2	4	4
6	June 24	3 eggs, 6 young	May 13	9	9	0	4	4
7	July 6	1 egg, 6 young	?	7	6	1	6	6
8	July 9	4 young	?	4	4	1 ¹	3	3
9	July 13	1 egg, 4 young	?	5	4	1 ²	1	4
10	July 19	2 young	?	2	2	?	2	2
11	July 24	5 young ³	?	5	5	?	5	5

¹ Egg found 200 yards from nest. ² Egg found two yards from nest. ³ Nest not found.

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SUMMARY

Many Snowy Owls nested near the head of Frobisher Bay, southeastern Baffin Island, in the summer of 1953. Ten nestings studied by us were all more or less successful. Clutch-sizes in these nests were: 10, 9, 9, 9, 9, at least 7, at least 5, at least 5, at least 4, at least 2. From 69 eggs, 62 chicks hatched, and we banded forty of these chicks.

Nests were on eminences, but not on the highest eminences available. Sites chosen afforded the owls a good view of their surroundings and some protection from the wind.

Nest territories were roughly circular and about a mile in diameter. When we approached nests, parent owls began hooting when we were a long way off but did not attack until we were within about a hundred yards. We were never attacked by more than two owls at once. In late June and early July only male owls attacked us, but later in the season some females attacked us savagely and some males did not attack at all.

Call notes included various hoots; a high, thin squeal (usually the female, but at one nest the male); a barking *ha, how, quack, quock*, or *quawk*, sometimes repeated in a wild volley (usually the male); and a crowed *ca-ca-oh* (female only). Defense included "rocking" distraction behavior accompanied by squealing but not by hooting.

The hatching period for a clutch of nine eggs was about 15 days (June 11-25); the chicks hatched about 40 hours apart. Estimated date for earliest egg-laying was May 4. The latest date for observed hatching of a chick was July 6. Latest date for observed young in the nest was July 19. The latest date for young unable to fly well was August 6. The latest date for young still partly in gray plumage was August 18.

The newly hatched chick was pure white, and its eyes were shut. At five to six days of age, dark gray plumage began pushing out the natal down, but the down clung tenaciously, giving the gray plumage a white tipping. The chicks left the nest when about two weeks old, long before being able to fly. At this stage they were gray with blackish gray facial mask. As white-and-gray-barred flight feathers appeared, a white facial mask replaced the dark. About the time the mask became wholly white, the chicks learned to fly. Dark plumage was visible on chest and back long after they were on the wing.

The owls fed exclusively on lemmings. These rodents were common in the area of greatest concentration of owls. Here there were no jaegers, foxes or gyrfalcons; weasels were very rare; and Rough-legged Hawks, Peregrines, Glaucous Gulls, and Herring Gulls were not common. The Raven, normally a lemming-eater, fed extensively at a dump near the Base and was not observed foraging at or near any owl's nest.

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BIRDS FROM CANLAON VOLCANO IN THE HIGHLANDS OF NEGROS ISLAND IN THE PHILIPPINES

By S. DILLON RIPLEY and D. S. RABOR

Several ornithological collectors have worked on Negros Island, which is the fourth largest of the 7090 islands that form the Philippine Archipelago. However, John Whitehead, the famous English naturalist, was the only person who collected extensively in the highlands of this island. Whitehead worked on the slopes of Canlaon Volcano, in the north-central section in March and April, 1896. Since that time no other collector has visited this volcano until April and May, 1953, when one of us, Rabor, collected in practically the same places in which Whitehead worked. This study of the birds of the highlands of Negros Island was carried on chiefly through the aid of the Peabody Museum of Natural History of Yale University.

TOPOGRAPHY AND GEOLOGY OF THE COLLECTING LOCALITIES

The principal central mountain chain traverses Negros Island from its northeast corner south to the southern end. This range lies closer to the east side than to the west and forms a divide throughout the extent of the island. A dormant volcano, Canlaon, with an elevation of about 8200 feet, is the most prominent peak in the north-central section of the mountain chain, and it is easily the dominant landmark of the western coastal plain.

Many of the mountains of Negros Island are volcanic (Smith, 1924). The north-western region, where most of the sugar cane is grown, is mainly of volcanic origin, whereas the southeastern portion consists of folded and faulted plutonic rocks, slates, and jaspers, probably of Mesozoic Age, and some Tertiary extrusives, all more or less dissected and worn down by erosion. The southeastern tip of Negros Island is also regarded as a highly volcanic area with Cuernos de Negros forming the southern counterpart of Canlaon Volcano (Smith, *op. cit.*).

The areas around Canlaon Volcano are without doubt volcanic, as shown by extensive layers of tuff and volcanic boulders cropping out from the otherwise level and rolling cultivated countryside at the base of the slope. The present cone of the volcano forms a southern bald, pointed peak which dominates the whole north-central region of Negros Island. A little to the northeast of Canlaon Volcano another peak rises which is known locally as Makawili. This mountain is about 8100 feet above sea level and has a luxuriant forest which extends to its top. Canlaon Town, a small village, is located in a plain at the base of the volcano.

The Margaha Valley, which is about 7000 feet above sea level, is situated between the present crater of Canlaon Volcano and Makawili Peak. It is a deep and roughly circular valley, surrounded by sheer rock walls, lying about 1200 feet below the cone of Canlaon Volcano. The total bottom area of this valley is about 40 hectares. The southern end is generally flat and level, comprising an area of approximately eight hectares, about two hectares of which are so flat as to appear levelled by a giant roller. This condition has been produced by layer upon layer of sediments which are deposited there by the water that floods and covers this area to a depth of one meter or more during the rainy months of July, August, September, October, and November. A small lake, about two hectares in area, develops in this southern end of the valley every year and disappears in the dry months from March to May.

The northern end of Margaha Valley consists of low hills covered with dwarfed vegetation similar to that found at the higher elevations of Makawili Peak. The valley is adjoined by vertical rock walls. The vegetation on the low hills must have come down

with the walls as they crumbled and has developed there over a long time. Makawili Peak and the present Canlaon Volcano cone represent the highest prominences on the vertical sides of Margaha Valley, and they are opposite each other. Due to erosion of the cone, this side of the valley presents a relatively gradual slope. Presumably a prehistoric explosion produced Margaha Valley, which is accordingly a remnant of an old crater of an immense volcano.

VEGETATION

On Canlaon Volcano collecting was carried on mainly from the following stations: Barrio Pula, elevation about 2600 feet; Sitio Pulapantao, elevation about 3600 feet, where the main camp was established; Sitio Danawan, elevation about 6500 to 7500 feet, where a small subcamp was established; and on the slopes of Makawili to the top of the peak. Some collections were also made in Masolog, elevation about 2200 feet, and on the slopes of Canlaon Volcano to about 7500 feet, or where the vegetation disappears.

The collecting areas may be divided into the following elevational zones based mainly on the types of vegetation and on the dominant bird species found in them:

Zone 1. 2500 to 4500 feet. Transition dipterocarp mid-mountain forest type.

Zone 2. 4500 to 6500 feet. Typical mid-mountain forest type.

Zone 3. 6500 to 8200 feet. Typical mossy forest type.

Actual collections were made starting from an elevation of about 2000 feet above sea level and proceeding to the tops of the mountains.

In the lists of birds collected in each zone, an asterisk before the name indicates the bird was not encountered by Whitehead; a dagger indicates the species was first described from Canlaon Volcano.

Zone 1.—On Canlaon Volcano this zone is first well represented at Pulopantao, 3000 feet above sea level. Below this elevation, the mountain slopes have been entirely cleared, cultivated and planted with tobacco, corn, rice, and vegetables. Between the patches of forests, new clearings have been made so that actually the virgin forests begin about 3500 feet above sea level.

The forests of the lower elevations of this zone, especially at the 2500- to 3500-foot level, are halfway between the genuine lowland dipterocarp forest type with its typically three-stories tree growths and the real mid-mountain forest type which occurs typically from about 4500 to 6500 feet above sea level. In this transitional type of forest, there is an abundance of very tall dipterocarp trees; these often reach heights of 120 feet, with the characteristic straight and unbranched boles ending in dense crowns at the top. There are, however, more of the second-story type of trees which are about 50 to 60 feet in height. The undergrowth is dense and consists mostly of ferns, small palms, and many species of shrubs.

At the 3500- to 4500-foot level, the very tall trees of the first-story disappear and the two-story character of the vegetation begins to assert itself. The trees now belong more to the real mid-mountain forest type. The taller story consists of trees from 50 to 60 feet in height which are equivalent to the second story of the real dipterocarp forest. The lower story consists of the third-story trees of the dipterocarp forest type which are 20 to 30 feet in height. The vegetation at this level is luxuriant and unbroken and forms a dense covering on the mountain slopes. The forest here is a moist, tropical rain forest. The crowns of the taller tree story do not produce as dense a canopy as the one formed by the crowns of the dominant tree story of the typical dipterocarp forest. The undergrowth is much more dense than that found at the 2500- to 3500-foot level; this is especially true of the rattan vegetation and epiphytic growth. Tree ferns are more abundant here than at the 2500- to 3500-foot level. Moss is noticeable on the main trunks and branches of the trees.

Vertebrate animal life is scarce, becoming more so with increase in elevation. Bird life is not as abundant as in the lowlands. It is strange that on Canlaon Volcano mixed feeding flocks of birds seemed rare. Also the feeding flocks had few individuals.

**Pernis celebensis steerei*.

**Accipiter trivirgatus extimus*. Thirty-five hundred feet above sea level.

**Accipiter virgatus confusus*.

Spilornis cheela panayensis.

**Megapodius freycinet pusillus*. First specimen recorded from Negros (see Rabor, 1952).

Phapitreron leucotis nigrorum.

Phapitreron amethystina maculipectus.

Leucotreron occipitalis occipitalis.

†**Ptilinopus arcanus*. Described in 1955.

Ducula poliocephala poliocephala.

Ducula carola nigrorum.

Macropygia phasianella tenuirostris.

**Streptopelia bitorquata dusumieri*. A lowland species found in cultivated areas and ranging only to 2500 feet.

Chalcophaps indica indica.

†*Prioniturus discurus whiteheadi*.

Loriculus philippensis regulus.

**Cuculus fugax pectoralis*.

**Cacomantis variolosus sepulchralis*.

**Centropus viridis viridis*.

**Ninox scutulata randi*.

**Batrachostomus septimus menagei*.

**Collocalia esculenta marginata*.

Hemiprocne comata major. Up to 3500 feet.

Halcyon smyrnensis gularis. Up to 3500 feet.

Halcyon chloris collaris. A lowland species, found to 2500 feet.

Halcyon lindsayi moseleyi. An unusual record at 3500 feet for this lowland species.

Eurystomus orientalis orientalis.

Penelopides panini panini.

Megalaema haemacephala intermedia.

Dendrocopos maculatus maculatus.

Chrysocolaptes lucidus xanthocephalus.

**Motacilla cinerea cinerea*.

**Motacilla flava simillima*.

**Anthus novaeseelandiae lugubris*.

Coracina striata panayensis.

Coracina ostenta.

Pericrocotus flammeus novus.

**Pycnonotus goiavier goiavier*. Found only near cultivation; rare above 2500 feet.

Microscelis philippensis guimarasensis.

†*Brachypteryx montana brunneiceps*. Not found below 3500 feet.

Copsychus saularis mindanensis. Found up to 2500 feet. [Grant (1896) described *Cittocinclia nigrorum* = *Copsychus luzoniensis superciliaris*. It is not clear whether the type came from Canlaon or merely Negros Island, but the species was not encountered on the present trip.]

Monticola solitaria philippensis.

**Stachyris speciosa*.

**Megalurus timoriensis tweeddalei*.

**Cisticola exilis rustica*.

**Locustella fasciolata*. A single specimen of this migrant taken at 3700 feet is the first record for Negros Island.

- Phylloscopus trivirgatus nigrorum*. Not found below 3500 feet.
- **Phylloscopus cebuensis*. Not found below 3500 feet.
- Phylloscopus borealis kennicotti*. One specimen of this migrant was taken at 2600 feet.
- Orthotomus atrogularis castaneiceps*. Ranges up to 3000 feet.
- Rhipidura cyaniceps albiventris*.
- Rhinomyias gularis albigularis*. A lowland species ranging up to 3600 feet.
- †*Muscicapa hyperythra nigrorum*.
- Muscicapa westermanni rabori*.
- Muscicapa griseisticta*. A winter visitant ranging up to 3500 feet.
- Muscicapa panayensis panayensis*.
- Culicicapa helianthea panayensis*.
- Pachycephala plateni winchelli*.
- Parus elegans visayanus*.
- Sitta frontalis aenochlamys*.
- **Rhabdornis inornatus rabori*.
- **Dicaeum agile aeruginosum*. A first record for Negros Island.
- Dicaeum bicolor inexpectatum*.
- **Dicaeum pygmaeum pygmaeum*. A lowland species rarely reaching 3500 feet.
- Dicaeum trigonostigma dorsale*.
- Dicaeum papuense haematostictum*. Common to 2500 feet, occasionally as high as 3500 feet.
- **Aethopyga flagrans guimarasensis*. This bird ranges normally from 2500 to 4500 feet. It stays usually in or close to forest. Delacour and Mayr (1946) write that the species is "fairly common in coconut plantations." On Negros Island this species has not been observed in this habitat.
- Aethopyga siparaja magnifica*.
- †*Zosterops montana pectoralis*. Not found below 3500 feet.
- **Zosterops nigrorum nigrorum*. A lowland species occasionally reaching 3500 feet.
- Sarcops calvus melanotus*.
- Lonchura leucogaster everetti*.
- Lonchura ferruginosa jagori*.
- Dicrurus balicassius mirabilis*.
- Oriolus xanthonotus steerei*.
- Corvus macrorhynchus philippinus*. Ranges as high as 3000 feet.
- Six species seen but not collected in this zone:
- | | |
|---------------------------------|----------------------------|
| <i>Gallus gallus</i> | * <i>Chaetura gigantea</i> |
| <i>Ninox philippensis</i> | * <i>Chaetura picina</i> |
| * <i>Collocalia troglodytes</i> | <i>Lanius cristatus</i> |

Zone 2.—The vegetation in this zone is typical mid-mountain forest type, showing a slight change in character upon reaching the 6000- to 6500-foot level. The two-storied character of the vegetation is very apparent from 4500 to about 5500 feet above sea level. Tree ferns are abundant at these elevations. Gymnosperms belonging to the mountain yew group, *Podocarpus* sp., occur about 5500 feet above sea level and become more abundant in the higher limits of this zone. *Pandanus* sp. are common, both as vines and ground growth.

Starting about 6000 feet, the forests begin to lose this distinctly two-storied character. The difference in height between the dominant trees and the lower growths is no longer as well marked as in the lower region of this zone. Beginning at 6000 feet, on both Canlaon and Makawili, *Podocarpus* sp. occurs singly, whereas at the summits of both peaks there is a good population of *Podocarpus*. Above 5500 feet the trees develop heavy growths of moss suspended from their branches, but there is not much moss on the trunks of the trees or on the forest floor. In some places, on the summits of the two peaks, moss forms a carpet on the ground. Water erosion has produced extensive cracks

which may be totally covered with moss; these cracks are sometimes of dangerous depths.

In this zone bird life is scarce.

Macropygia phasianella tenuirostris.

**Cacomantis variolosus sepulcralis*. Rarely as high as 5000 feet.

**Collocalia esculenta marginata*.

Microscelis philippensis guimarasensis.

†*Brachypteryx montana brunneiceps*.

†*Turdus poliocephalus nigrorum*. Not found below 6000 feet.

Phylloscopus trivirgatus nigrorum. Most abundant between 4000 and 6500 feet.

**Phylloscopus cebuensis*.

Phylloscopus borealis kennicotti.

Rhipidura cyaniceps albiventris.

†*Muscicapa hypertythra nigrorum*.

Muscicapa westermanni rabori.

Pachycephala plateni winchelli.

Parus elegans visayanus.

†*Zosterops montana pectoralis*.

Zone 3.—This zone is well developed on Canlaon Volcano. Sitio Danawan, on the way to Makawili has a similar type of vegetation. The trees definitely lose their two-storied character. *Pandanus* is still plentiful and dominant. *Podocarpus* is very common and seems to be the dominant species from about 7000 feet to nearly the top of Makawili Peak. The trees are heavily coated with moss both on the trunks and on the branches. The forest floor is thickly carpeted with moss.

At about 8000 feet and above, on Makawili, the trees become stunted and twisted. Even the *Podocarpus* which grew taller at lower elevations, becomes stunted and is only about as high as a man of average height. In Margaha Valley the trees are very stunted. This seems strange because the vegetation in the valley is not subjected to the stunting effects of very strong winds.

At the top of Canlaon, vegetation stops at about 7500 feet. The last 600 to 700 feet of the slope are bare rocks and gravel with a few grasses and weeds at the 7600- to 7700-foot level.

Ducula carola nigrorum. A single bird was taken at 7200 feet, indicating that this species is highly migratory locally since it is common near sea level during September, October, and November.

Macropygia phasianella tenuirostris. Taken at 7500 feet.

**Collocalia esculenta marginata*. Up to 7500 feet.

Coracina ostenta. A specimen was taken at 7100 feet.

†*Brachypteryx montana brunneiceps*. Up to 8100 feet.

†*Turdus poliocephalus nigrorum*.

Turdus obscurus. A migrant, one specimen of which was collected at 6700 feet.

Phylloscopus trivirgatus nigrorum. More common in Zone 2.

†*Muscicapa hypertythra nigrorum*. Up to 7000 feet.

Muscicapa westermanni rabori.

Pachycephala plateni winchelli. Up to 7500 feet.

Parus elegans visayanus. Less abundant above 6500, but reaches 7500 feet.

†*Zosterops montana pectoralis*.

Falco peregrinus. Seen, but not collected, immediately around the Canlaon Crater at 7500 feet; noted also by Whitehead (*vide* Grant, 1896:529-530).

SPECIES SHOWING BREEDING ACTIVITY, ENLARGED GONADS OR DEVELOPED OVA
IN THE PERIOD FROM APRIL 11 THROUGH MAY 21

<i>Phapitreron leucotis nigrorum</i>	<i>Collocalia esculenta marginata</i> . Nest taken
<i>Phapitreron amethystina maculipictus</i>	(for notes on nesting see Rabor, 1954).
<i>Leucotreron occipitalis occipitalis</i>	<i>Megalaema haemacephala intermedia</i>
<i>Ducula poliocephala poliocephala</i>	<i>Chrysocolaptes lucidus xanthocephalus</i>
<i>Ducula carola nigrorum</i>	<i>Coracina striata panayensis</i>
<i>Macropygia phasianella tenuirostris</i>	<i>Microscelis philippensis guimarasensis</i>
<i>Prioniturus discurus whiteheadi</i>	<i>Brachypteryx montana brunneiceps</i>
<i>Cuculus fugax pectoralis</i>	

Turdus poliocephalus nigrorum. On May 5, in the Margaha Valley, a nest of this thrush with two eggs in an advanced state of incubation was found in a low tree about four feet above the sloping hillside. It was securely placed in a fork of the branches of the tree. The nest was a thick cup made of mosses, roots, and twigs, and it was lined inside with grass. It measured: outside diameter 180 mm.; inside diameter 100 mm.; depth outside 100, inside 50 mm. The two eggs agreed very closely with Grant and Whitehead's description (1898), being regular ovals, with the shell well mottled and blotched with reddish on a very light-green ground color.

<i>Stachyris speciosa</i>	<i>Culicicapa helianthea panayensis</i>
<i>Phylloscopus trivirgatus nigrorum</i>	<i>Parus elegans visayanus</i>
<i>Phylloscopus cebuensis</i>	<i>Sitta frontalis aenochlamys</i>
<i>Orthotomus atrogularis castaneiceps</i>	<i>Rhabdornis inornatus rabori</i>
<i>Rhipidura cyaniceps albiventris</i>	<i>Dicaeum agile aeruginosum</i>
<i>Muscicapa hyperthra nigrorum</i>	<i>Dicaeum bicolor inexpectatum</i>

Dicaeum trigonostigma dorsale. A nest of this species of flowerpecker was found on April 11 at Pulo Pantao. The nest was an oval structure suspended at its upper end from the underside of a frond of a tree fern. It was close to the end of the frond and was about eight feet from the ground. It had a circular opening on one side of its upper half and measured: top to bottom 135 mm.; middle external diameter 73 mm.; diameter of cavity inside 25 mm. The bottom of the nest was very thick and the whole structure was composed of the very fine powdery down which coats the stems and petioles of the tree ferns. Three nestlings left the nest after a week.

<i>Dicaeum pygmaeum pygmaeum</i>	<i>Aethopyga flagrans guimarasensis</i>
<i>Dicaeum ignipectus apo</i>	

Zosterops montana pectoralis. A nest of the Mountain White-eye with two eggs was found in the Margaha Valley in a stunted tree. It was placed securely in a fork about four feet from the sloping hillside. The nest was cup-shaped and was composed of fine roots and plant fibers. It was coated with moss on the outside and was lined with very fine hair-like roots, possibly from epiphytic ferns found in the area. The nest measured: outside diameter 73 mm.; inside diameter 49 mm.; depth outside 55 mm.; inside 27 mm. The eggs were long and oval, creamy-white in color, with one slightly pointed end. They measured 17×12 mm., and 18×12 mm.

<i>Zosterops nigrorum nigrorum</i>	<i>Sarcops calvus melanonotus</i>
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Lonchura ferruginosa jadori. Several nests were found in the tall grass along creeks in well-cultivated areas between Barrio Pula and the town of Canlaon. In some gardens, in the locality where orange trees were growing, as many as 6 to 12 nests were found in one tree. Most of these were in use at the same time.

Dicrurus balicassius mirabilis. The presence of young birds of different ages indicated that breeding must have started as early as February.

Oriolus xanthonotus steerei.

Corvus macrorhynchus philippinus. A nest was seen in a fork near the top of a tall dipterocarp which was left standing at the edge of a cornfield near a gully at Pulo Pantao.

MIXED FLOCKS ON CANLAON

Wandering mixed flocks were very noticeable on Mount Canlaon. The species composition of these flocks differed with altitude. The lower altitude mixed-flock association

was predominant in virgin forest from 1000 to 3500 feet, with a few species ranging higher to 5000 feet. The highland mixed-flock association was found primarily above 5000 feet, although a few species descended to 3500 feet. Thus the zone from 3500 to 5000 feet was a marginal one of ecological overlap.

The lowland group consisted of the following species: Rough-templed Tree-Babbler (*Stachyris speciosa*), Arctic Willow Warbler (*Phylloscopus borealis*, winter visitant), Blue-headed Fantail (*Rhipidura cyaniceps*), Elegant Titmouse (*Parus elegans*), Yellow White-eye (*Zosterops nigrorum*), and Balicassiao (*Dicrurus balicassius*). *Rhipidura* is the "leader" of such mixed flocks. It is a curious species, usually not afraid to fly and perch on a branch very close to an observer. When this occurs, the remaining members of the flock continue with their feeding activities as if nothing were happening and later they may move on. *Rhipidura* is the last to move on but subsequently it usually flies on ahead of the group, singing all the while, and again leads the flock. *Dicrurus* is also a very curious bird and it often disturbs the flock with its alarm calls. At times it seems as if this species takes over the leadership and direction of a flock from *Rhipidura*.

At 3500 feet, the following species appear for the first time and join the mixed flocks: Mountain Leaf Warbler (*Phylloscopus trivirgatus*), Thicket Flycatcher (*Muscicapa hypertythra*), Westernmann Flycatcher (*Muscicapa westermanni*), and Mountain White-eye (*Zosterops montana*). All these species continue to the highest level of the forest. Of them, *Zosterops* seems the most plentiful numerically; no conspicuous leadership was noted.

NOTES ON CALLS

A few notes on calls were made which may be of interest.

Phapitreron amethystina. Amethyst Brown Fruit Dove. The Negros race of this species possesses a characteristic loud honking call that closely resembles the *honk-honk-honk* sound of an old automobile horn. More rarely it calls rather like the common Philippine Coucal (*Centropus viridis*).

Macropygia phasianella. Slender-billed Cuckoo Dove. This bird calls with a mournful *tok-wao*, *tok-wao*, repeated several times with a moderate interval between.

Streptopelia bitorquata. Philippine Turtle Dove. This species has a very clear call, *tuk-m-m-m*, repeated several times after moderate intervals.

Centropus viridis. Philippine Coucal. The call of this bird is a characteristic loud *co-co-co-co* in a mournful monotone, the syllables being repeated after equal intervals. When excited, it makes low, harsh, repeated *chabbook-dot* calls, usually as it retreats into the dense tangles of grass or mixed vegetation nearby.

Penelopides panini. Tarictic Hornbill. An appropriately named bird, as its notes sound roughly like *te-rik-tik-tik-tik*; the *tiks* follow each other rapidly.

Turdus poliocephalus. Island Thrush. When disturbed, this thrush flew off rapidly in thick forest, uttering, on the wing, a peculiar note, *tr-r-r-r-r-eeek*, as it flashed by.

Orthotomus atrogularis. Common Tailor-bird. This species has a loud unmistakable call, *tr-r-r-r-r-r*, *tag-wa-tit*, *tag-wa-tit*, *tig-wa-to-tit*, repeated over and over.

Muscicapa hypertythra. Thicket Flycatcher. A shy and secretive bird which has a soft characteristic note sounding like *ps-s-s-s-t* uttered in a hissing manner.

SYSTEMATIC NOTES

Leucotreron occipitalis occipitalis (G. R. Gray). Yellow-breasted Fruit Dove. The form *brevipes* Hachisuka (1930) from Mount Apo is synonymous with *incognitus* Tweeddale. The type of *brevipes* is in the Ripley collection and proves to represent a distinctively small race. Four adult *incognitus* from Mindanao measured: wing, 144 (type of "*brevipes*"), 140, 144, 147; tail, 99 (type), 94, 104, 104; culmen, 15 (type), 15-17 mm. Eleven adult *occipitalis* from Negros measured: wing, 155-166; tail, 104-124; culmen, 15.5-18.0 mm. The race *incognitus* has about the same amount of gray on the crown as in *occipitalis* (contra Hachisuka, 1932), but it is somewhat more bronzy on the back and more dull yellowish on the throat.

Ducula poliocephala poliocephala (G. R. Gray). Pink-bellied Imperial Pigeon. A specimen of Hachisuka's *nobilis* from Davao in the Ripley collection is inseparable from typical *poliocephala*.

Phylloscopus borealis kennicotti (Baird). Arctic Willow Warbler. The small size of two females taken in spring would seem to align them with the Alaskan population. These birds have no trace of a yellowish wash on the underparts. Wing, 61.0, molt; tail, 43.5, molt; culmen, 12.0, 12.5 mm.

Rhabdornis inornatus rabori Rand. Plain-headed Creeper. The series taken agrees well with Rand's original description (1950), although five out of 12 specimens do not show the pronounced black blotches on the hind neck. In size the tail appears longer and the culmen shorter than in his type series.

	Wing	Tail	Culmen
5 ♂♂	93.0-99.0	63.0-67.5	17.0-19.0 mm.
6 ♀♀	91.5-95.5	58.5-64.0	16.0-18.0 mm.

Dicaeum ignipectus apo Hartert. Fire-throated Flowerpecker. Three specimens agree with typical *apo* from Mindanao in having the sides of the head glossy, greenish-black instead of slaty as in *luzoniense*. The vent and under tail coverts are not always brighter in *apo* as stated by Hartert (1904). The flanks and sides of the abdomen are richer, more olive grayish-green. The single female is duller than females of *apo* but it matches that population far better than *luzoniense*, although it indicates as might be expected a somewhat intermediate position. In size these birds agree with *apo*.

	Wing	Tail	Culmen
2 ♂♂	53.0, 53.5	28.0, 28.0	9.5, 10 mm.
♀	51.0	26.5	9.5 mm.

Aethopyga flagrans guimarasensis Steere. Flaming Sunbird. These birds support Rand's comments (1951) on the differences between *guimarasensis* and *flagrans*.

Zosterops montana pectoralis Mayr. Mountain White-eye. Delacour and Mayr (1945:116) described *Zosterops montana pectoralis* from Canlaon, pointing out that it was quite different from *Zosterops palpebrosa siquijorensis* with which it had formerly been confused. The latter, a pale race of *Zosterops palpebrosa*, does not seem to occur on Negros Island (Rabor, 1952:257), but it is replaced in the lowlands of Negros by *Zosterops nigrorum*.

A series of specimens of *Zosterops montana* from Mount Cuernos de Negros on Negros Island indicates the existence of two races of the Mountain White-eye, the second of which may be named as follows:

Zosterops montana finitima, new subspecies

Type.—♂ adult, Y. P. M. no. 23475, collected at Luzuniaga, 4000 feet, Cuernos de Negros, Negros Island, Philippine Islands, on January 3, 1953, by D. S. Rabor. Paratype ♂ adult, Silliman University Natural History Museum, no. 4070, collected at Luzuniaga on December 31, 1952, by D. S. Rabor.

Diagnosis.—From *pectoralis* of Mount Canlaon this form differs by being smaller, by having a reduced yellow wash on the lower breast and abdomen, and by paler cheeks. The flanks are more gray and are washed with vinous. There is a tendency also for the upper parts to be slightly more yellowish in series. This form differs from *whiteheadi*, *halconensis*, *vulcani*, and *diuatae* Salomonsen (1953) by having distinctly more yellow on the under parts, by extension of yellow farther down the breast and by having a broad median streak of yellow from breast to crissum. Compared to *Zosterops palpebrosa siquijorensis*, this form is somewhat larger and longer billed, and it is much brighter above and on the throat and crissum, with a much yellower wash on the lower breast and a broader median line.

No. of specimens		Wing	Tail	Culmen
46	<i>pectoralis</i> ♂♂♀♀	55-60 (mean 57.7; σ 1.308)	39-44 (41.2; σ 1.581)	13-15 mm.
21	<i>finitima</i> ♂♂♀♀	53-57 (mean 54.4; σ 1.389)	33-40 (37.4; σ 1.546)	12-14 mm.

Comparison of these figures by using the table of *t* for small samples gives a figure for *t* in the case of the wing measurements of 4.6, and in the case of the tail measurements of 5.08. In each case the *P* value is less than 0.01, indicating that the difference between the samples is significant.

We are grateful to the authorities of the United States National Museum and the Chicago Natural History Museum for the loan of pertinent material of *Zosterops palpebrosa siquijorensis*.

Sarcops calvus melanotus Grant. Coletto. Twelve specimens from Negros have wing measurements from 122–138 mm. which completely overlap the values for wings of seven specimens from Mindanao that range from 124 to 128 mm. In coloration of throat and back, these birds also agree, thus seemingly rendering unnecessary the separation of the Negros birds as *similis* (Salomonsen, 1952). Six birds from the southwestern peninsula of Mindanao in the Ripley collection have wing measurements of 124 mm. or over, thus failing to support the race *minor* (Salomonsen, 1952) from Cotobato.

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FROM FIELD AND STUDY

Nesting Records of the Arctic Willow Warbler in Mount McKinley National Park, Alaska.—The Arctic Willow Warbler (*Acanthopneuste borealis kennicottii*) is a common summer resident in Mount McKinley Park, Alaska. My earliest record of their spring appearance is May 28 and my latest summer record is August 17. No special effort was made to obtain early or late records. The warblers are usually found in patches of willows 10 to 15 feet tall. They were plentiful along Igloo Creek which is bordered by willows, and in extensive patches of willow on slopes in Polychrome Pass and west of the Toklat River beyond timber line. Near Savage River I found them in the open spruce woods in which grew an understory of willows.

The males are tireless songsters. All day and into the evening one may hear their loud, penetrating song which resembles that of the Pileolated Warbler but is more vigorous and incisive. Frequently a sharp *tzeet* is repeated two or three times between the song phrases. This *tzeet* is a worry call, and I think that it is when the birds are worried that they insert the *tzeet* in their singing. When singing near me the worry note was inserted, but when a bird is undisturbed this note is usually omitted.

The male early establishes itself in a rather restricted area. On Igloo Creek two males could always be heard singing about 75 yards apart. On June 20, 1955, I heard five singing males within an area about 200 yards in diameter. The birds seemed more numerous than usual in 1955, although this is just an impression.

A few times I observed a singing male fluttering its partly open, drooping wings, creating thus a soft fluttering sound, which was audible several yards away. The fluttering sound was also made while the bird was flying from one perch to another.

In 1955 I occasionally looked for a nest, but with no success until eggs were hatched and I could watch the adults carrying food. Earlier I failed to see females, except on July 3 when I caught a glimpse of a second bird, presumably a female, while I was following the worried calling of a male.

On July 23 I stopped along Igloo Creek about 4:30 in the afternoon and sat down on a hummock to watch a warbler, just on the chance of finding a nest. Soon I heard warblers calling about 30 yards away and saw one fly into a low clump of willows with food in its bill. Both parents entered the clump, but when I looked for the nest, I was unable to find it. Then I watched from about 10 yards away, and in a few minutes saw a parent fly to the clump and then to the nest opening on the side of a mossy hummock. The nest was built in a depression, the opening of a mouse tunnel. The cup of the nest was a rather compact structure made of interwoven fine grass and caribou hair. The cup was canopied with loosely piled moss which blended with the moss of the hummock. The entrance to the nest was on the lower side and measured about 2 inches wide and 1½ inches high. The surface dimensions of the moss canopy measured about 4½ inches by 3½ inches. The entire nest fitted neatly into a one-pound coffee can.

A second nest found the following day along Igloo Creek was on the flat, moss-covered ground under a growth of willows about four feet tall. The nest cup was in a slight depression and, like the other, was composed of fine grass and caribou hair. The canopy of the nest consisted of loosely piled moss which overlapped the nest cup considerably, its surface measuring 10 inches by 4 inches. The piled up moss made a slight heap, while in the first nest the top of the canopy was on the same plane as the moss around it. The entrance was on one side, the overlapping moss forming a short tunnel to the nest entrance.

In the first nest there were four newly hatched young and one egg when I first looked in, but a few minutes later I saw the parent carry away the shell of the last-hatched egg. Both parents fed the young, and one of the parents brooded them briefly. One adult was more timid than the other. Occasionally it brought food, called worriedly from the willows a few feet from the nest, but did not go to it until the mate arrived. Then it would crowd in beside its mate at the nest entrance to feed the young. At this time the young were being fed almost entirely on green larvae.

On August 2, the day I left the area, I removed the first nest and fashioned one as a substitute. The young at this time were ready to fly. One of them escaped from my hand and fluttered off four or five feet. The parents continued feeding the young after they were placed in the substitute nest. About two hours later when I looked at the nest, two of the young had left. If undisturbed they might have remained in the nest a day or two longer, in which event the period in the nest would have amounted to 11 or 12 days.

The young in the second nest were a little older when found. They left it either on July 28 or 29.

On July 26 I watched a third pair of birds feeding a family that had but recently left its nest, so it appears that the young on the average are ready to leave the nest by the latter part of July. There is, however, a possibility that the nesting season was delayed some in 1955 because of the late spring and that ordinarily nesting would take place a week or so earlier.

According to the account of this willow warbler in Bent (U.S. Nat. Mus. Bull. 196, 1949:332), no nest of the willow warbler has previously been recorded for North America.—ADOLPH MURIE, *Moose, Wyoming, February 13, 1956.*

Notes on a Nest of the Guianan Chachalaca.—The Guianan Chachalaca (*Ortalis motmot*) is rather common in the coastal area and the savanna region of Surinam. It is not a bird of thick forests but its favorite habitat is dense patches of jungle along the rivers and creeks and also the sandy savanna's covered with scattered and almost impenetrable bushes and surrounded on all sides by forest. It is not averse to cultivation, provided it is not too intensive, and it often frequents deserted and thickly overgrown plots of cultivation.



Fig. 1. Nest of *Ortalis motmot* with three eggs. Zanderij, Surinam, December 4, 1955. Photograph by F. Haverschmidt.

The native name for this chachalaca in Surinam is "Wakago" (= walk and go), which is well chosen and gives an excellent transcription of the call note which indeed is one of the most characteristic bird notes of the country. I particularly remember how the loud and rapidly repeated *wákágō*, *wákágō* sounded at sunrise from all directions when I was staying at the Indian village of Apoura at the Corentyne River on June 14, 1953.

Being a secretive bird that usually is seen only when suddenly flushed from a thick tangle, very little of its nesting habits is known. Its eggs are not represented in the large egg collection assembled in Surinam for the Penard brothers and which is now preserved in the Leyden Museum (Hellebrekers, Zoöl. Mededeelingen, 24, 1942). The Penard brothers (De Vogels van Guyana, vol. 1, 1908) tell us that it nests in the short dry season which lasts from mid-February to mid-April.

On December 4, 1955, which is in the short rainy season lasting from mid-November to mid-

February, I flushed a Wakago from a small bush on the savanna at Zanderij near the edge of the forest. The bird disappeared in a surprisingly noiseless flight and uttered only a few cackling alarm notes. The nest was in a fork of a rather small shrub at a height of about two meters at the very edge of the bush. Near it was a small wasp's nest. The nest was amazingly small for such a large bird and it was made of small roots and flattened leaves of the surrounding shrubs. The nest cup was lined with dead as well as fresh green leaves, suggesting that building and up-keeping had continued during the laying period. The nest contained three rather rough-shelled, white eggs which filled the cup. Two of the eggs were nest stained to a considerable extent, from which it may be supposed that the eggs had been laid with an interval of more than one day. The eggs were fresh, one of them being distinctly smaller than the two others. The measurements and weight of the unblown eggs were: 56.9×38.1 mm., 44 gms.; 55.0×38.9 mm., 38.2 gms.; 52.2×36.2 mm., 44 gms. The measurements of these eggs fall within the limits of those mentioned in the literature.

The weight of four adult Wakago's collected by me in Surinam was: 3 ♂ 493, 495 and 500 gms., 1 ♀ 385 gms. The weight of a fresh egg is therefore about one-tenth of the body weight of the birds.—F. HAVERSCHMIDT, Paramaribo, Surinam, January 7, 1956.

A White-throated Golden-crowned Sparrow.—On April 29, 1951, an adult female *Zonotrichia* was collected one and three-fourths miles northwest of Los Gatos, Santa Clara County, California. The bird had an ovary measuring 5 millimeters in length and heavy deposits of subcutaneous fat. Although appearing to be a Golden-crowned Sparrow (*Zonotrichia atricapilla*), this bird had a pure white throat. As might be expected my first reaction was that the specimen was a hybrid between the Golden-crowned Sparrow and the White-throated Sparrow (*Z. albicollis*). Comparisons with specimens in the Museum of Vertebrate Zoology and the Stanford Natural History Museum were therefore made.

The pileum is like that of *atricapilla*, having a median patch of yellow bordered laterally by broad black stripes and posteriorly by an area of light gray or whitish. There is no indication of the white superciliary stripe of *albicollis* although some normal *atricapilla* show a considerable amount of gray in the black postocular region. The supraloral region, which is yellow in *albicollis*, is black in the specimen as it is in *atricapilla*. Careful examination of this region will reveal a few yellow-tipped feathers in normal *atricapilla*. These are also present in the specimen. The tones of brown in the scapular region of *albicollis* are more rufescent than in *atricapilla*. The specimen is like normal *atricapilla* in this respect. The specimen lacks the yellow area at the carpal joint found in *albicollis* but absent in *atricapilla*, and the anterior underparts are olivaceous gray as in *atricapilla*, rather than medium gray as in *albicollis*. In all other areas of the plumage the specimen is similar to normal individuals of *atricapilla*.

Thus it is only in the possession of an extensive pure white throat that the specimen suggests that one of its parents may have been a White-throated Sparrow. The entire throat area is immaculate white, even more so than in a female *albicollis* taken at the same locality on April 19, 1951, just 10 days before the white-throated Golden-crown was collected. In *albicollis* the white throat is sharply demarcated from the gray breast and blackish malar stripes are often present. The throat of the present specimen blends gradually into the breast and lacks any trace of black edges. Thus, although pure white, it actually is quite different in its detailed appearance from the throat pattern of *albicollis*.

Some specimens of *atricapilla* have a number of white feathers at the base of the bill, and the throat in all normal individuals tends to be lighter than the breast. In the Stanford Natural History Museum there are two specimens of *Z. atricapilla* with some white in the throat. A male (no. 1578) taken at Redwood City, San Mateo County, California, on April 14, 1917, has the throat paler than normal specimens and it is streaked with dusky. A female (no. 859) taken on April 18, 1893, has the chin and lower throat white with a dusky area in between. In the Museum of Vertebrate Zoology there is a specimen (no. 31349) of an immature female collected in the Moraga Valley, Contra Costa County, California, on November 9, 1919, which has the center of the throat white bordered by dusky malar stripes. These facts suggest that there is a normal genetic basis for white in the throat plumage of *atricapilla*. It seems probable that the white throat in this otherwise normal specimen of *atricapilla* is due, not to hybridization, but either to the chance coalition of a larger than usual number of mul-

multiple factors affecting white throat plumage or to a mutation which affected the deposition of pigment in the feathers of this area.

Although the evidence is slight, it is tempting to speculate upon the possible significance of the white throat in this individual. The fact that the throat is the area involved suggests that the genetic basis is similar to that which produces the normal white throat of the related *albicollis*. That there is a genetic proclivity for white in the throat in the genus *Zonotrichia* is further suggested by a specimen of the White-crowned Sparrow of the race *Zonotrichia leucophrys gambeli* in the Stanford Natural History Museum. This bird (no. 7982), a male from Redwood City, collected on April 15, 1922, has a very pale throat with faint dusky malar stripes. It seems likely that the white throat of *Z. albicollis* became fixed as a specific character when selection favored just such occasional white-throated individuals as these noted in its present congeners. The white throat acquired a signal function, probably in connection with species recognition, and thus may be important as an isolating mechanism. Selection against hybrids may be the source of selection pressure which has produced, and is maintaining, the species differences among the members of the genus. Hybridization among the four North American species is possible since two or more are frequently sympatric. Miller (Condor, 42, 1940: 45-48) has described a hybrid Golden-crowned x White-crowned and the White-throated has been found breeding near Hazelton, British Columbia, where the Golden-crowned is also present (Brooks and Swarth, Pac. Coast Avif. No. 17, 1925:94). The White-throated, White-crowned, and Harris' Sparrow (*Z. querula*) are in contact in varying degrees in other parts of Canada. Although the significance in the present context is difficult to assess, it may be noted that the White-throated Sparrow has hybridized with the Slate-colored Junco (*Junco hyemalis*) on at least two known occasions (Townsend, Bull. Nuttall Ornith. Club, 8, 1883:78-80; Snyder, Auk, 71, 1954:471).

The white-throated Golden-crowned Sparrow is now no. 24800 in the Cornell University collection.—CHARLES G. SIBLEY, *Department of Conservation, Cornell University, Ithaca, New York, February 27, 1956.*

Noteworthy Bird Records from Northeastern Nevada.—The field activities of the personnel of the Nevada Fish and Game Commission in the eastern part of Nevada is providing a better understanding of the avifauna of this poorly known area. Recent records of note from Elko County are here reported.

Polioptila caerulea. Blue-gray Gnatcatcher. Linsdale (Condor, 53, 1951:241) gives central Nye County as the northernmost record for this species. On June 7, 1953, Hoskins found a pair nesting in a riparian association along the South Fork of the Humboldt River, about 16 miles south of Elko and about 140 miles farther north than the record cited above. A second record for Elko County is that of a single bird seen by Gullion at Cherry Spring, about 11 miles southwest of Elko, on July 22, 1955.

Lanius excubitor. Boreal Shrike. Linsdale (*op. cit.*, p. 242) indicates a number of records from northwestern Nevada, but none from Elko County. In 1955 we had five records of this species in this area, as follows: one bird found dead on the highway over Adobe Summit, 6900 feet elevation, 7 miles northwest of Elko (now specimen no. 132731 in the collection of the Museum of Vertebrate Zoology), and another seen near Dinner Station, 18 miles north of Elko, both on January 28, by Hoskins. On March 9, Gullion observed a third bird along the Humboldt River, 5100 feet elevation, 8 miles west of Elko. A fourth record was obtained by Gullion when an early fall arrival was seen on November 23, at 6080 feet elevation on the west side of Crawford Mountain, 19 miles southwest of Elko. The fifth record was an adult female (no. 133869) collected by Gullion at about 5800 feet elevation, 4 miles southwest of Boone Springs and 70 miles southeast of Wells, on December 3. All these birds were seen while a mantle of snow covered the entire area.

On December 3, a Loggerhead Shrike (*Lanius ludovicianus*) was seen below the snow-line along the west side of the Great Salt Lake Desert, 8 miles southwest of Wendover, 38 miles northeast of the collection site for the Boreal Shrike and 1500 feet lower.—GORDON W. GULLION and LEONARD W. HOSKINS, *Nevada Fish and Game Commission, Elko, Nevada, December 20, 1955.*

NOTES AND NEWS

The American Ornithologists' Union will hold its seventy-fourth annual meeting in Denver and Boulder, Colorado, September 4 to 9, 1956.

Of international interest to ornithologists are certain actions recently taken with respect to names of birds by the International Commission on Zoological Nomenclature. To achieve a compromise between European and American usages and contentions, the generic name *Gavia* was accepted for the loons (divers) and the generic name *Colymbus* was suppressed for the grebes, *Podiceps* being accepted in its stead. Also the following well known generic names were validated (older homonyms suppressed): *Bubo*, *Coturnix*, *Egretta*, *Oriolus*. The generic name *Gallinago* was accepted for the snipes in place of *Capella*. Names of Linnaeus published in 1776 in Edwards' Natural History were suppressed for technical reasons, thus making unnecessary certain unfortunate name changes for North American birds.—A.H.M.

At the recent annual meeting of the Cooper Ornithological Society held in Seattle, Washington, the following papers were presented on June 15: Under Water Locomotion of the Dipper, by William R. Goodge; Spatial and Seasonal Variations in Distribution of Sea Birds in the Gulf of the Farallones, California, Howard L. Cogswell; United States Fish and Wildlife Program in the Pacific Northwest, Stanley G. Jewett; Seasonal Distribution of Waterfowl Population Loss, J. Burton Lauckhart; Comparative Anatomy of the Leg Muscles of Gallinaceous Birds, George E. Hudson and Patricia J. Lanzillotti; Foraging Behavior and Hind Limb Structure of Towhees, John Davis; Natural History of Oregon (evening motion picture), Kenneth L. Gordon.

On June 16: The Incubation of the Yellow-eyed Penguin, Donald S. Farner; Temperature Regulation of Nestling Terns and Nighthawks, Thomas R. Howell; The Effect of Ecologic Tolerance on Speed of Microevolution of Birds and Mammals, Alden H. Miller; Pictorial Survey of the Native Hawaiian Birds, R. L. Pyle; History of One Hundred Nests of the California Gull, William H. Behle; Distribution and Migration of the Black Rosy Finch, Norman R. French; Color Variation among Nestling Nighthawks, Eben McMillan and John E. Taft; Bird Behavior [especially of Kittiwakes], Niko Tinbergen.

Field trips to Protection Island and to Mount Rainier proved highly successful and pleasurable.

The meetings were sponsored by the Pacific Northwest Bird and Mammal Society and the University of Washington on the occasion of the summer meetings of the Pacific Division of the American Association for the Advancement of Science.

COOPER SOCIETY MEETINGS

SOUTHERN DIVISION

APRIL.—The monthly meeting of the Southern Division of the Cooper Ornithological Society was held on April 24, 1956, at Los Angeles County Museum. The following names were proposed for membership: Emmet R. Blake, Chicago Natural History Museum, Roosevelt Rd. and Lake Shore Dr., Chicago 5, Ill., and Dr. Prentis T. Burtis, 2500 Edwards Ave., El Cerrito, Calif., by Jack C. von Bloeker, Jr.; Charles P. Hibler, Box 534, State College, New Mexico, by Richard F. Johnston; Leland L. Stallcup, 6227 Buenaventura, Oakland 5, Calif., by Enid K. Austin; Mr. Bob Bayly, 1759 Franklin Blvd., Eugene, Oregon, and Val Nolan, Jr., Indiana University School of Law, Bloomington, Indiana, by C. V. Duff.

"Nicaraguan Journey," was the subject of speaker, Dr. Thomas R. Howell of the Department of Zoology of the University of California at Los Angeles. His talk was illustrated with Kodachrome slides, study skins and a short colored motion picture.—DOROTHY E. GRONER, Secretary.

NORTHERN DIVISION

APRIL.—The meeting of the Northern Division of the Cooper Ornithological Society was held on April 5, 1956, at the University of California, Berkeley. New members proposed were David H. McAlpin, Box 670, Princeton, N.J., by Alden H. Miller, and W. A. Labarthe, Rural Rt. 1., Edith Avenue, Corning, Calif., by Beatrice W. Nielsen.

Howard Cogswell stated that 30 Clark Nutcrackers recently were seen along the road from Olema to Bolinas Lagoon in Marin County.

Dr. George W. Salt of the University of California at Davis gave "A Preliminary Report on Geographic Variations in the Weights of Birds."

—LILLIAN K. HENNINGSEN, Secretary.

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A

Abdulali, Humayun, 75 Abdul Rehman St., Bombay 3, India. 1947.
Adams, Claude T., Dept. Biology, Univ. Florida, Gainesville, Fla. 1951.
Adams, William H., Jr., Box 5785, Univ. Sta., Baton Rouge, La. 1952.
Adelson, Richard H., 34 Wensley Dr., Great Neck, N.Y. 1950.
Aigner, Philip E., 1255 Club View Dr., Los Angeles 24, Calif. 1955.
Albright, Ray, Rt. 1, Box 277, Dayton, Ore. 1950.
Albro, Mary S., 29 Mosswood Rd., Berkeley 4, Calif. 1928.
Alcorn, Gordon D., College of Puget Sound, Tacoma 6, Wash. 1942.
Alcorn, Joseph R., Museum of Natural History, Univ. Kansas, Lawrence, Kan. 1939 (1947) [L.].
Aldrich, Elmer C., 5631 Camellia Ave., Sacramento 19, Calif. 1935.
Aldrich, John W., 21 W. Spring St., Alexandria, Va. 1942.
Alexander, Gordon, Dept. Biology, Univ. Colorado, Boulder, Colo. 1941.
Allen, Arthur A., Cornell Univ., Ithaca, N.Y. 1911.
Allen, Esther C., Camarillo State Hospital, Camarillo, Calif. 1951.
Allen, Herbert, 822 Wildrose Ave., Monrovia, Calif. 1956.
Allis, Comdr. Frederick A., U.S.N., Hq. U.S. EUCOM (Compt.), APO 128, % Postmaster, New York, N.Y. 1950.
Alperin, Irwin M., 2845 Ocean Ave., Brooklyn 35, N.Y. 1947.
Altman, Stuart A., Biological Labs., Harvard Univ., Cambridge 38, Mass. 1955.
Alvarez del Toro, Miguel, Apartado Postal No. 6. Tuxtla Gutierrez, Chiapas, Mexico. 1948.
Amadon, Dean, American Museum of Natural History, Central Park at 79th St., New York 24, N.Y. 1943.

- Anderson, A. H., 3221 E. Kleindale Rd., Tucson, Ariz. 1932.
- Anderson, Allen E., 37 Orchard Park, Dexter, N. M. 1956.
- Anderson, Charles H., 1015 Connely St., Salinas, Calif. 1947.
- Anderson, Earl A., 7335 N. Odell Ave., Chicago 13, Ill. 1952.
- Anderson, Frank G., Dept. Sociology, Univ. Maryland, College Park, Md. 1951.
- Anderson, James D., Museum of Vertebrate Zoology, Berkeley 4, Calif. 1954.
- Anderson, William, Box 983, Los Baños, Calif. 1948.
- Andrews, Arthur A., 75 Penfield Crescent, Brighton Sta., Rochester 10, N.Y. 1927.
- Annan, Ormsby, 270 Birch St., Winnetka, Ill. 1951.
- Antevs, Ada, "The Corral," Globe, Ariz. 1946 (1947) [L.].
- Appel, Thomas G., 63 Sunnyside Ave., Pleasantville, N.Y. 1951.
- Appelman, F. J., Stichting Rotterdamsche Diergaarde, Rotterdam, Netherlands. 1953.
- Applegarth, John H., California Polytechnic College, San Luis Obispo, Calif. 1927.
- Appleton, J. S., R.F.D., Simi, Calif. 1901 (1920) [L.].
- Arbib, Robert S., Jr., 231 W. Lena Ave., Freeport, N.Y. 1947.
- Argante, Mrs. A. J., 1404 La Sierra Dr., Sacramento 21, Calif. 1955.
- Armington, Sven, Box 19081, Stockholm 19, Sweden. 1951.
- Armitage, Hal, 4926 Ethel Ave., Sherman Oaks, Calif. 1953.
- Armstrong, Fairbairn H., Box 97, Pomeroy, Wash. 1954.
- Armstrong, Virginia, Old Concord Rd., South Lincoln, Mass. 1947.
- Arnett, John H., Jr., 6200 Ardleigh St., Philadelphia 38, Pa. 1955.
- Arnold, Hubert A., 533 E St., Davis, Calif. 1956.
- Arnold, John R., 834 W. Mariposa St., Stockton 4, Calif. 1930.
- Arnold, Ralph, 3162 Calle Fresno, Santa Barbara, Calif. 1893.
- Arny, Samuel A., 6515 Williston Dr., Apt. 2, Falls Church, Va. 1947.
- Aronoff, Arthur E., 11 Fifth Ave., New York 3, N.Y. 1948 (1955) [L.].
- Arsenault, Barbara J., 16025 Miami Way, Pacific Palisades, Calif. 1954.
- Arvey, M. Dale, Dept. Biology, Long Beach State College, Long Beach 15, Calif. 1953.
- Ashcraft, Granville P., Box 438, Etna, Calif. 1940.
- Atkins, Carolyn C., 2924 Santa Cruz Dr. S.E., Albuquerque, N.M. 1949.
- Atsatt, Sarah R., 405 Hilgard Ave., Los Angeles 24, Calif. 1911.
- Austin, Mrs. Harold C., 1116 Mandana Blvd., Oakland 10, Calif. 1939.
- Austin, Oliver L., 28 Fairview Ave., Tuckahoe 7, N.Y. 1931.
- Ayer, Mrs. N. Edward, 1300 Hillcrest Dr., Pomona, Calif. 1929.

B

- Badger, M. C., Rt. 1, Box 98, Santa Paula, Calif. 1915.
- Baepler, Donald H., Dept. Zoology, Univ. Oklahoma, Norman, Okla. 1956.
- Bailey, Alfred M., Colorado Museum of Natural History, Denver 6, Colo. 1917.
- Bailey, Laura B., Rockbridge, Alum Springs, Rt. 2, Goshen, Va. 1915 (1920) [L.].
- Bailey, Richard, 1107 High Court, Berkeley 8, Calif. 1949.
- Baily, A. Lang, III, 2253 Newberry St., Davenport, Iowa. 1952.
- Baker, John H., 1165 5th Ave., New York 29, N.Y. 1930.
- Baker, Paul S., 21 Woodlot Lane, Huntington, L. I., N.Y. 1945.
- Baker, Rollin H., The Museum, Michigan State Univ., East Lansing, Mich. 1946.
- Bakker, Gerhard, Jr., 1034 S. Mansfield Ave., Los Angeles 19, Calif. 1954.
- Baldwin, Paul H., Dept. Zoology, Colorado A. & M. College, Fort Collins, Colo. 1943.
- Baldwin, William G., Dept. Otolaryngology, Univ. Iowa Hospital, Iowa City, Iowa. 1953.
- Balsom, Mrs. Amos P., 2209 E. Stratford Court, Milwaukee 11, Wis. 1948.
- Baltzar, Evelyn C., 9921 S. Overest Ave., Whittier, Calif. 1946.
- Banks, Richard C., Museum of Vertebrate Zoology, Berkeley 4, Calif. 1956.
- Bard, Fred G., Provincial Museum, Public Health Bldg., Regina, Saskatchewan, Canada. 1948.
- Barnes, F. R., 4282 Maple Ave., Oakland 2, Calif. 1947.
- Barnett, A. Houston, 341 S. Cañon Dr., Beverly Hills, Calif. 1955.
- Barrett, Vernon, 1300 Chelton Way, South Pasadena, Calif. 1948.
- Bartel, James N., 1741 Denison St., Pomona, Calif. 1951.
- Bartholomew, George A., Jr., Dept. Zoology, Univ. California, Los Angeles 24, Calif. 1942.
- Bartleson, Fred D., Jr., Rt. 3, Box 556, Fort Myers, Fla. 1953.
- Basey, Harold E., Box 62, Riverdale, Calif. 1954.
- Bassett, Frank N., 722 N. Orange Dr., Los Angeles 38, Calif. 1919.
- Battles, Carroll D., 2347 S. Highland Ave., Los Angeles 16, Calif. 1920.
- Batts, H. Lewis, Jr., 1211 Glenwood Ave., Kalamazoo, Mich. 1947.

- Baumel, Julian J., Dept. Anatomy, Creighton Med. School, Omaha 2, Nebr. 1953.
- Baumbardt, John, 500½ Mound Ave., South Pasadena, Calif. 1937.
- Baumgarten, Gail G., 4323 Bakman Ave., North Hollywood, Calif. 1950.
- Bayly, Bob, 1759 Franklin Blvd., Eugene, Ore. 1956.
- Beasley, Clarence C., Box 619, Santa Monica, Calif. 1947.
- Beaudette, Palmer T., R.F.D. 1, Box 228, Solvang, Calif. 1956.
- Beebe, Hiram E., 1847 N. Wilcox Ave., Hollywood 28, Calif. 1948.
- Beebe, William, N. Y. Zoological Soc., 185th St. and Southern Blvd., New York 60, N.Y. 1926.
- Beecher, William J., Chicago Natural History Museum, Chicago 5, Ill. 1948.
- Beemer, Eleanor G., Pauma Valley, Calif. 1946.
- Behle, William H., Biology Bldg., Univ. Utah, Salt Lake City 12, Utah. 1933.
- Beidleman, R. G., Zoology Dept., Colorado A. & M. College, Fort Collins, Colo. 1948.
- Belcher, Sir Charles F., Burnley House, Kokstad, Cape Province, South Africa. 1948.
- Belcher, Paul E., 98 Grandin Rd., Akron 13, Ohio. 1945.
- Belkin, Daniel A., 6255 Drexel Ave., Los Angeles 48, Calif. 1954.
- Bell, A. Weir, 365 S. Hoover St., Los Angeles 5, Calif. 1936.
- Bellrose, Frank C., Illinois Natural History Survey, Havana, Ill. 1953.
- Belt, R. Elmer, 1893 Wilshire Blvd., Los Angeles 5, Calif. 1942.
- Bender, Richard O., Cobb's Mill Rd., R. D. 1, Bridgeton, N. J. 1951.
- Benjamin, Gilbert G., Jr., 2304 Blueridge Ave., Apt. 105, Wheaton, Silver Spring, Md. 1939.
- Benne, Bartles L., 317 N. Kensington, Kansas City 23, Mo. 1956.
- Bennett, Robert J., 3548 Steinway St., Astoria, L. I. C. 3, N.Y. 1954.
- Bennett, Walter W., 7828 Santa Monica Blvd., Hollywood 46, Calif. 1934.
- Benson, Seth B., Museum Vertebrate Zoology, Berkeley 4, Calif. 1927.
- Berger, Andrew J., Dept. Anatomy, East Medical Bldg., Univ. Michigan, Ann Arbor, Mich. 1947.
- Berger, Daniel D., 510 E. MacArthur Rd., Milwaukee 17, Wis. 1954.
- Bergstrom, E. Alexander, 37 Old Brook Rd., West Hartford 7, Conn. 1942.
- Berkey, Glen T., 22 S. State St., Rittman, Ohio. 1951.
- Berry, William D., 1651 Ard Eevin Ave., Glendale 2, Calif. 1951.
- Berryman, Carl, 128 W. Euclid Ave., Stockton 4, Calif. 1953.
- Berwick, Freda W., Room 548, Mills Tower, 220 Bush St., San Francisco 4, Calif. 1955.
- Bialac, James T., 1641 W. Pierson St., Phoenix, Ariz. 1955.
- Bibbee, Paul C., Concord College, Athens 4, West Va. 1947.
- Biddle, John A., 418 Westbourne St., La Jolla, Calif. 1947.
- Binford, Laurence C., Museum of Zoology, Univ. Michigan, Ann Arbor, Mich. 1955.
- Bird, Dick, 2721 Assiniboine Ave., Regina, Saskatchewan, Canada. 1956.
- Blackford, John L., Libby, Mont. 1952 (1952) [L.].
- Blackstone, Robert E., 10363 Calvin Ave., Los Angeles 25, Calif. 1953.
- Blain, Alexander W., 1028 Berkshire Rd., Grosse Pointe 30, Mich. 1926.
- Blake, Charles H., Woodland Way, Lincoln, Mass. 1947.
- Blake, Emmet R., Chicago Natural History Museum, Roosevelt Rd. and Lake Shore Dr., Chicago 5, Ill. 1956.
- Blanchard, Dean H., 729 Mission Canyon Rd., Santa Barbara, Calif. 1930.
- Bleitz, Don, 2047 Castilian Dr., Hollywood 28, Calif. 1944 (1952) [L.].
- Bliese, John C. W., Dept. Biology, Nebraska State Teachers College, Kearney, Nebr. 1953.
- Bloom, Reginald T., % Barclay's Bank, Ltd., Queensway Branch, Nairobi, Kenya, East Africa. 1956.
- Bock, Walter, 7630 85th Dr., Woodhaven 21, N.Y. 1954.
- Bohl, Wayne H., 851 Don Diego, Santa Fe, N.M. 1953.
- Bolander, Gordon L., 538 Flover Ave., Santa Rosa, Calif. 1943.
- Bond, Richard M., Virgin Islands Corp., Kingshill, St. Croix, U.S. Virgin Islands. 1936.
- Bonestall, Aileen E., Dept. Bacteriology, Univ. California, Berkeley 4, Calif. 1954.
- Booth, Ernest S., Dept. Biology, Walla Walla College, College Place, Wash. 1939.
- Booth, Katherine F., 1085 Bank St., Painesville, Ohio. 1953.
- Borell, Adrey E., Soil Conservation Service, 321 New Custom House, Denver 7, Colo. 1918.
- Bosbyshell, F. H., 545 S. Figuero St., Los Angeles 17, Calif. 1951.
- Boulton, Rudyerd, 3234 Reservoir Rd. N.W., Washington 7, D.C. 1939.
- Bourne, Raymond D., Box 187, Oxford, Ohio. 1947 (1951) [L.].
- Bowdish, B. S., 16 Van Horn St., Demarest, N. J. 1910.
- Bowen, Lydia S., 841 Earlham St., Pasadena 4, Calif. 1948.
- Bowers, Darl E., 2211 Grant St., Berkeley 3, Calif. 1949.
- Bowers, J. Basil, 975 Juanita Ave., Campbell, Calif. 1947.

- Bowman, Mabelle, 51 Marr Ave., Oakland 11, Calif. 1949.
- Bowman, Robert I., 2704 Virginia St., Berkeley 9, Calif. 1948.
- Boyd, Elizabeth M., 23 Jewett Lane, South Hadley, Mass. 1948.
- Boyle, Ashby D., 61 University St., Salt Lake City 2, Utah. 1915.
- Boyne, Elmer M., 624 Nixon, Reno, Nev. 1951.
- Boynton, F. H., 163 W. State St., Pasadena 2, Calif. 1948.
- Bracelin, Mrs. H. P., 2214 Vine St., Berkeley 9, Calif. 1930.
- Brackbill, Hervey G., 2620 Poplar Dr., Baltimore 7, Md. 1945.
- Bradburn, Donald M., 461 Pine St., New Orleans 18, La. 1953.
- Brandt, John H., Gen. Del., Durango, Colo. 1956.
- Brattstrom, Bayard H., Dept. Zoology, Univ. California, Los Angeles 24, Calif. 1956.
- Brauner, Joseph, 3350 San Marino, Los Angeles 6, Calif. 1946.
- Brittan, Martin R., Dept. Life Sciences, Sacramento State College, Sacramento 19, Calif. 1948.
- Broadbooks, Harold E., 1525 E. Third St., Hermiston, Ore. 1942.
- Brode, J. Stanley, 478 24th St., Santa Monica, Calif. 1934.
- Brodkorb, Pierce, Dept. Biology, Univ. Florida, Gainesville, Fla. 1940.
- Brodrick, Neva M., 721 Cleveland Ave., Oakland 6, Calif. 1949.
- Brody, Gerald L., University Hospital, Ann Arbor, Mich. 1955.
- Broline, Signa L., 829 E. Claremont St., Pasadena 6, Calif. 1948.
- Brooks, Matilda M., 630 Woodmont Ave., Berkeley, Calif. 1949.
- Brooks, William E., Rt. 1, Box 100, Colton, Calif. 1940.
- Brown, Asa L., Box 532, Herlong, Lassen Co., Calif. 1938.
- Brown, Jerram L., 19 Hitchcock Rd., Amherst, Mass. 1952.
- Brown, Martin D., Jr., 11319 S. Fidel Ave., Whittier, Calif. 1954.
- Brown, Ollie D., 8964 Wonderland Ave., Los Angeles 46, Calif. 1952.
- Brown, Mrs. Thomas H., 4254 Ampudia St., San Diego 3, Calif. 1946.
- Browne, Andrew C., 350 Delmas Ave., San Jose 26, Calif. 1950.
- Bruns, James H., St. Francisville, La. 1949.
- Bryant, Harold C., 245 Glorietta Blvd., Orinda, Calif. 1910 (1920) [L.J.].
- Bryant, Wayne W., Wind Cave National Park, Hot Springs, So. Dak. 1952.
- Bryens, Oscar McK., 231 S. Main St., Three Rivers, Mich. 1927.
- Bull, D. Bernard, Box 608, La Mesa, Calif. 1950.
- Burch, Mrs. John Q., 4206 Halldale Ave., Los Angeles 62, Calif. 1947.
- Burleigh, Thomas D., College of Forestry, Univ. Idaho, Moscow, Idaho, 1956.
- Burns, John M., Museum of Vertebrate Zoology, Berkeley 4, Calif. 1956.
- Burns, Robert D., Dept. Zoology, Michigan State Univ., East Lansing, Mich. 1954.
- Burt, William H., Museum Zoology, Univ. Michigan, Ann Arbor, Mich. 1928.
- Burtis, Prentis T., 2500 Edwards Ave., El Cerrito, Calif. 1956.
- Burton, Donald E., 171 Strathearn Rd., Toronto 10, Ontario, Canada. 1955.
- Bushman, John B., Ecological Research, Univ. Utah, Dugway, Utah. 1952.
- Buss, Irven O., Dept. Zoology, Washington State College, Pullman, Wash. 1955.
- Butler, Thomas S., 10326 Moorberry Lane, Houston 24, Texas. 1955.
- Butterworth, Bernard B., 1225 W. 39th Pl., Los Angeles 37, Calif. 1956.

C

- Cade, Cecil E., Box 568, Nairobi, Kenya, East Africa. 1956.
- Cade, Tom J., 526 Gayley St., Los Angeles 24, Calif. 1950.
- Cady, Walter G., 3350 Calvert Rd., Pasadena 8, Calif. 1951.
- Cahalane, Victor H., New York State Museum, Albany 1, N.Y. 1938.
- Calder, James A., Buena Park, Calif. 1917.
- Calef, Robert T., 734 E. University, Ann Arbor, Mich. 1955.
- Camp, Charles L., Museum Paleontology, Univ. California, Berkeley 4, Calif. 1909.
- Campbell, Raymond A., 686 Fourth Ave., Chula Vista, Calif. 1953.
- Campbell, Mrs. William H., Rt. 2, Box 871-A, Tucson, Ariz. 1940.
- Caram, Marguerite, 42 Rue Montoyer, Brussels, Belgium. 1955.
- Cardiff, Bruce E., N. W. Cor. Cactus and Bloomington Aves., R. F. D. 1, Rialto, Calif. 1948.
- Cardiff, Eugene A., 2736 Court St., Rialto, Calif. 1947.
- Carey, Joshua H., Dept. Anatomy, Univ. Michigan, Ann Arbor, Mich. 1936.
- Carmony, Duane, 223 S. Bryan, Bloomington, Ind. 1955.
- Carnes, Mrs. Herbert E., 31 Dogwood Lane, Tenafly, N. J. 1947.
- Carpenter, Nelson K., 5026 Westminster Terr., San Diego 16, Calif. 1901.
- Carson, Carl L., 67 Duncan Way, Oakland 11, Calif. 1948.
- Carter, Frances, 2200 College Ave., Berkeley 4, Calif. 1934.

- Cassel, J. Frank, Dept. Zoology, North Dakota Agr. College, Fargo, N. D. 1946.
- Castenholz, Richard W., Botany Dept., Washington State College, Pullman, Wash. 1955.
- Caswell, Herbert H., Jr., Michigan State Normal College, Ypsilanti, Mich. 1950.
- Chalif, Edward L., 37 Barnsdale Rd., Short Hills, N. J. 1948 (1952) [L.].
- Chambers, Carl W., 514 Marquette St., Pacific Palisades, Calif. 1936.
- Chambers, W. Lee, R. R. 1, Box 294, Topanga, Calif. 1897 (1919) [L.], (1936) [Honorary].
- Chapelle, Maj. Francis O., U. S. Army Hospital, West Point, N. Y. 1954.
- Chapman, Lawrence B., R. F. D. Box 90, Hubbardston, Mass. 1949.
- Childs, Henry E., Jr., 15053 Neartree St., La Mirada, Calif. 1947.
- Christensen, Ruth, 7037 Alvern St., Apt. C, Los Angeles 45, Calif. 1953.
- Christman, Gene M., 77 Edgecroft Rd., Berkeley 7, Calif. 1946.
- Church, Ronald L., 122 Eleventh St., Pacific Grove, Calif. 1954.
- Clapp, Clara M., 3962 Dalton Ave., Los Angeles 62, Calif. 1956.
- Clark, George A., Jr., 1 W. Campus, Easton, Pa. 1956.
- Clark, Harold W., Pacific Union College, Angwin, Calif. 1948.
- Clarke, Oscar F., 1012 Indianapolis Ave., Riverside, Calif. 1951.
- Clarke, William S., Jr., Box 167, State College, Pa. 1948.
- Clarkson, Mrs. Edwin O., Wing Haven, 248 Ridgewood Ave., Charlotte, N. C. 1945 (1953) [L.].
- Clary, Marjorie D., 7630 Cimarron St., Los Angeles 47, Calif. 1929.
- Clattenburg, Albert E., Jr., F. S. O. Nice, % Dept. of State, Washington 25, D. C. 1947.
- Claxton, Fritz R., 2516 Etna St., Berkeley 4, Calif. 1949.
- Clay, C. Irvin, Box 353, Eureka, Calif. 1910 (1923) [L.].
- Clements, H. Everest, 49 Stoneham Rd., Rochester 10, N. Y. 1951 (1951) [L.].
- Clements, William F., 1500 N. Beverly Dr., Beverly Hills, Calif. 1952.
- Clow, Marion, Box 163, Lake Forest, Ill. 1945.
- Coakley, Katharine T., Mariposa, Calif. 1954.
- Coble, Mary F., 1357 N. Stanley Dr., Hollywood 46, Calif. 1954.
- Coggins, Herbert L., 2764 Filbert St., San Francisco 9, Calif. 1910.
- Cogswell, Howard F., Dept. Biological Sciences, Mills College, Oakland 13, Calif. 1940.
- Coil, E. Fisher, 1867 Fort Stockton Dr., San Diego 3, Calif. 1951.
- Cole, William W., Jr., R. D. 3, Box 316, Apollo, Pa. 1956.
- Collier, Gerald, 3634 N. Muscatel Ave., Rosemead, Calif. 1953.
- Collins, Percy L., 18 Vanderbilt Ave., Milltown, N. J. 1951.
- Colton, Harold S., Museum Northern Arizona, Box 601, Flagstaff, Ariz. 1936.
- Combella, C. Rose B., 3021 Friendly St., Eugene, Ore. 1952.
- Compton, Lawrence V., Biology Div., Soil Conservation Service, Washington 25, D. C. 1927.
- Conan, Norman G., 1789 Fiske Ave., Pasadena 6, Calif. 1951.
- Cone, Lt. Col. Hutchinson I., Jr., J5 Div., Hq. F.E.C., APO 500, % PM, San Francisco, Calif. 1940.
- Congdon, Russell T., 203 Palouse St., Wenatchee, Wash. 1945.
- Conway, William G., St. Louis Zoo, Forest Park, Saint Louis 10, Mo. 1955.
- Cooch, Graham, 685 Echo Dr., Ottawa 1, Ontario, Canada. 1954.
- Cooper, Mrs. James S., 2907 Florence St., Berkeley 5, Calif. 1944.
- Cottam, Clarence, Welder Wildlife Foundation, Box 1104, Sinton, Texas. 1926.
- Cottrell, George W., Jr., 70 Lakeview Ave., Cambridge 38, Mass. 1945.
- Couffer, Jack C., Canyon Films, 1213 N. Highland Ave., Hollywood 38, Calif. 1942.
- Courtright, Mary L., 3 Elm Ave., Larkspur, Calif. 1936.
- Covel, Paul F., 2860 Delaware St., Oakland 2, Calif. 1935.
- Cowan, Ian McT., Dept. Zoology, Univ. British Columbia, Vancouver, B. C., Canada. 1937.
- Cowan, John B., Gray Lodge Refuge, Box 655, Gridley, Calif. 1946.
- Cowles, Raymond B., Zoology Dept., Univ. California, Los Angeles 24, Calif. 1928.
- Craig, Alan M., 5401 Fair Oaks Blvd., Carmichael, Calif. 1954.
- Craig, Ethel B., 4309 Victoria Ave., Los Angeles 8, Calif. 1956.
- Cramer, Frances L., 921 W. 36th Pl., Los Angeles 7, Calif. 1940 (1943) [L.].
- Crawford, Franklin G., 2782 Glen Ave., Altadena, Calif. 1939.
- Crockett, Harry L., 76 E. Columbus Ave., Phoenix, Ariz. 1924.
- Crompton, Alfred O., Laurie Ave., Salisbury, South Australia, 1948.
- Crosby, John, Jr., Gardnerville, Nev. 1953.
- Crouch, James E., San Diego State College, San Diego, Calif. 1934.
- Crowell, John B., Jr., 201-A Holden Green, Cambridge 38, Mass. 1956.
- Culbertson, A. E., 529 Ashlan Ave., Fresno 4, Calif. 1937.
- Cunningham, James W., 3009 E. 19th Terr., Kansas City 1, Mo. 1945.

- Curl, A. Lawrence, 751 Balra Dr., El Cerrito 8, Calif. 1947.
 Curtis, Vee K., 2412 Cohasset Rd., Chico, Calif. 1945.
 Cuthbert, N. L., 1001 S. Franklin St., Mount Pleasant, Mich. 1953.
 Cutler, Betsey D., 2128 Great Highway, San Francisco 16, Calif. 1955.

D

- Dahl, Richard G., 47 Lakemont Dr., Daly City, Calif. 1938.
 Dales, Loring G., 1555 Club View Dr., Los Angeles 24, Calif. 1955.
 Daly, Brian, 445 Magellan Ave., San Francisco 16, Calif. 1956.
 D'Angelo, Angelo R., 809 Palisade Ave., Union City, N. J. 1947.
 Darby, Rollo E., 2103 Walnut Ave., Carmichael, Calif. 1946.
 Davidson, John B., 327 Driftwood Rd., Corona del Mar, Calif. 1950.
 Davidson, W. M., 1504 Bodell St., Orlando, Fla. 1947.
 Davis, Clifford V., Dept. Zoology, Montana State College, Bozeman, Mont. 1948.
 Davis, David E., 615 N. Wolfe St., Baltimore 5, Md. 1936.
 Davis, Edwin G., 1316 22nd St. S., Baltimore 5, Md. 1936.
 Davis, Henry R., 418 Floral Park Terr., South Pasadena, Calif. 1953 (1953) [L.].
 Davis, John, Hastings Natural History Reservation, Jamesburg Rt., Carmel Valley, Calif. 1938.
 Davis, L. Irby, Box 988, Harlingen, Tex. 1940.
 Davis, Platt A., 1947 Marion St., Albany, Ore. 1951.
 Davis, William B., Box 254, Faculty Exchange, College Station, Tex. 1930 (1950) [L.].
 Dawson, Richard G., 6114 Indiana Ave., Kansas City 30, Mo. 1949.
 Dawson, William R., Dept. Zoology, Univ. Michigan, Ann Arbor, Mich. 1945.
 Day, Leonard H., Box 126, Davis, Calif. 1944.
 Deane, A. Lawrence, 911 Preston Ave., Blacksburg, Va. 1955.
 Deane, Mrs. Ruthven, 830 Hibbard Rd., Winnetka, Ill. 1939 (1939) [L.].
 DeGroot, Dudley S., Athletic Br., S.A.D., USAR-Eur., APO 245, % Postmaster, New York, N.Y. 1916.
 Deignan, Herbert G., U.S. National Museum, Washington 25, D.C. 1949.
 Delacour, Jean, Los Angeles County Museum, Exposition Park, Los Angeles 7, Calif. 1927 (1949) [L.].
 De Lury, Ralph E., Manilla, Ontario, Canada. 1926.
 Denham, Reginald H., 100 Central Park South, New York 19, N.Y. 1946.
 Dennis, Robert, 135 Purdue Ave., Berkeley 8, Calif. 1952.
 Denton, J. Fred, 1510 Pendleton Rd., Augusta, Ga. 1949.
 De Schauensee, R. M., Jongleur Farm, S. Devon Ave., Devon, Pa. 1950.
 Desmond, Thomas C., Box 670, Newburgh, N.Y. 1945 (1948) [L.].
 Deuel, Harold F., 110 Hill St., Arcata, Calif. 1951.
 Deuprey, Mrs. Clifton S., 817 University St., Healdsburg, Calif. 1935.
 Dickerman, Robert W., Museum of Natural History, Univ. Kansas, Lawrence, Kan. 1951.
 Dietz, Curt, Box 3039, Stanford, Calif. 1950.
 Dignam, John H., 4 Basswood Rd., Willowdale, Ontario, Canada. 1954.
 Dilger, William C., Laboratory of Ornithology, Cornell Univ., Ithaca, N.Y. 1952.
 Dirks-Edmunds, Jane C., Linfield College, McMinnville, Ore. 1948.
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 Farner, Donald S., Dept. Zoology, State College of Washington, Pullman, Wash. 1945.
 Fasnacht, Carl L., 328 Ross St., Lancaster, Pa. 1955.
 Featherstone, Mrs. W. H., 132 King St., Wallace, Idaho. 1951.
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 Fennell, Chester M., 19239 Coffinberry Blvd., Fairview Park 26, Ohio. 1950.
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 Follett, W. I., 3501 Broadway, Oakland 11, Calif. 1926 (1949) [L.].
 Ford, Mary C., 2360 Scout Rd., Oakland 11, Calif. 1951.
 Fordham, Stephen C., Jr., Delmar Game Farm, Delmar, N.Y. 1947.
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- Greer, Edward C., 422 E. 10th St., Davenport, Iowa. 1949.
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 Hughes, Herbert E., 6648 Tujunga Ave., North Hollywood, Calif. 1953.
 Hughes, William H., 8755 S.W. Marine Dr., Vancouver 14, B. C., Canada. 1949.
 Humphrey, Mrs. Harry B., 715 W. Fremont Ave., Los Altos, Calif. 1952.
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 Hunt, Gerald M., 3911 Alicia Dr., San Diego 7, Calif. 1955.
 Huntington, Charles E., Dept. Biology, Bowdoin College, Brunswick, Maine. 1951.
 Hurd, Paul D., Jr., Dept. Entomology & Parasitology, College of Agriculture, Univ. California, Berkeley 4, Calif. 1940.
 Hurley, John B., 401 S. 17th Ave., Yakima, Wash. 1921.
 Hutchinson, Magdeleine C., 2640 Glendessary Lane, Santa Barbara, Calif. 1940.
 Hutson, Glen A., 725 Blossom St., Bakersfield, Calif. 1955.
 Hyde, A. Sidney, Western State College, Gunnison, Colo. 1939.
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 Jacobsen, Eric C., Box 233, Ripon, Calif. 1950.
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 Jaeger, Edmund C., 4465 Sixth St., Riverside, Calif. 1922.
 Jahn, Frances F., 10241 Chrysanthemum Lane, Los Angeles 24, Calif. 1948.
 James, Douglas A., Box 3566, Arsenal, Ark. 1947.
 Jasse, Robert F., 3809 Spruce St., Philadelphia 4, Pa. 1955.
 Jefcoat, Arthur W., Inskip P. H., Paynes Creek, Calif. 1937 (1948) [L.J].
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 Jenks, Randolph, 2146 E. Fourth Street, Tucson, Ariz. 1931.
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 Johnsgard, Paul A., Dept. Zoology, Washington State College, Pullman, Wash. 1955.
 Johnson, Alfred W., % Katz Johnson, S. A. C. Casilla 327, Santiago de Chile. 1951.
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 Johnson, Harald N., Box 429, Berkeley 1, Calif. 1955.
 Johnson, H. McClure, Div. Meteorology, Box 37, Roberts Hall, Cornell Univ., Ithaca, N.Y. 1952.
 Johnson, H. V., 972 W. Broadway, Eugene, Ore. 1947.
 Johnson, John C., Jr., Dept. Zoology, Univ. Oklahoma, Norman, Okla. 1955.
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 Johnson, Ned K., 624 Lake St., Reno, Nev. 1950.
 Johnson, Ray R., Jr., 3898 Filion St., Los Angeles 65, Calif. 1950.
 Johnston, David W., Dept. Biology, Mercer Univ., Macon, Ga. 1949.
 Johnston, Richard F., Dept. Biology, New Mexico A. & M. College, Las Cruces, N. M. 1947.
 Johnston, Verna R., 1812 W. Sonoma Ave., Stockton 4, Calif. 1943.
 Jones, F. Nowell, Dept. Psychology, Univ. California, Los Angeles 24, Calif. 1953.
 Jones, George G., 2930 E. Third St., Tucson, Ariz. 1954.
 Jones, George R., 17124 Celtic St., Granada Hills, Calif. 1950.
 Jones, John C., 5810 Namakagan Rd., Glen Mar Park, Washington 16, D. C. 1940.
 Jones, S. Paul, 509 West Ave. N., Waukesha, Wis. 1929.
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 Keating, Paul J., 1705 S. 41st St., Tacoma 8, Wash. 1952.

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- Legg, Ken, Prairie Creek State Park, Orick, Calif. 1954.
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- Locke, Louis, Box 33, Lockeford, Calif. 1948.
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- Lofthouse, William C., 6511 Pollard St., Los Angeles 42, Calif. 1954.
- Long, Roberta, 45 Clarendon Ave., San Francisco 14, Calif. 1951.
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- Manning, Thomas H., 37 Linden Terr., Ottawa 1, Ontario, Canada. 1951.
- Mannix, Lucille M., 3899 E. 176th St., Cleveland 28, Ohio. 1948.
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- Mayhew, Wilbur W., 6727 Mt. Whitney Ave., Riverside, Calif. 1946.
- Mayr, Ernst, 21-A Washington Ave., Cambridge 40, Mass. 1933.
- Mazzeo, Rosario, 114 The Fenway, Boston 15, Mass. 1946.
- McAllister, Tom, Jr., 3374 S.W. Fairmount, Portland 1, Ore. 1948.
- McAlpin, David H., Box 670, Princeton, N. J. 1956.
- McAttee, W. L., 3 Davie Circle, Chapel Hill, N. C. 1907.
- McBride, Charlotte A., 2224 Via Guadalupe, Palos Verdes Estates, Calif. 1954.
- McCabe, Robert A., 424 University Farm Pl., Madison 6, Wis. 1947.
- McClure, H. Elliott, 406 Med. Gen. Lab., APO 343, % Postmaster, San Francisco, Calif. 1947.
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- McElroy, Mildred, 404 Gladstone Blvd., Shreveport, La. 1948.
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- Medina, Don, 364 Roswell Ave., Long Beach 14, Calif. 1954.
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- Miller, Robert C., California Academy of Sciences, Golden Gate Park, San Francisco 18, Calif. 1921.
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- Miskimen, Mildred, Miami Univ., Oxford, Ohio. 1953.
- Mitchell, Ormond, Box 485, Lakeside, Calif. 1955.
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- Mock, Ronald M., 7436 McCool Ave., Los Angeles 45, Calif. 1948.
- Moeller, B. A., 489 Prospect Terr., Pasadena 3, Calif. 1935.
- Monk, Harry C., 406 Avoca St., Nashville 5, Tenn. 1925.
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- Monroe, Lt. J. G. Burt L., Jr., % Francis M. Weston, 2006 E. Jordan St., Pensacola, Fla. 1954.
- Monroe, Morgan, 2802 N. 21st St., Phoenix, Ariz. 1955.
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- Montgomery, Vester, 1302 N. Pennsylvania Ave., Roswell, N. M. 1952.
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- Moody, Marjorie J., 1380 Veterans Ave., Apt. 1, Los Angeles 24, Calif. 1946.
- Moody, Nina, 547 13th St., Richmond 5, Calif. 1955.
- Moody, Rollen W., 1169 Colorado Blvd., Denver, Colo. 1951.
- Moore, Donald W., 211-A Mitscher Rd., China Lake, Calif. 1949.
- Moore, Mrs. McBrayer, 335 W. Lexington St., Danville, Ky. 1951.
- Moore, Milton C., Apt. 3, 501 Lincoln Ave. N.W., Canton 8, Ohio. 1955.
- Moore, Robert T., 582 Meadow Grove Pl., Pasadena 3, Calif. 1911 (1947) [L.], (1950) [Honorary].
- Moran, Robert B., 170 E. Orange Grove, Pasadena 3, Calif. 1901.
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- Morel, Elton L., 2637 E. Glenoaks, Glendale 6, Calif. 1955.
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- Neldam, Mrs. George, 304 La Espiral, Orinda, Calif. 1949.
- Nelson, Mrs. Roy F., 650 Blair Ave., Piedmont 11, Calif. 1947.
- Nelson, Theodora, 315 E. 68th St., New York 21, N.Y. 1940.
- Ness, Robert D., 17 Five Points Rd., Rush, N.Y. 1953.
- Nevius, John R., Jr., 1847 W. 68th St., Los Angeles 47, Calif. 1955.
- Newman, Robert J., 312 W. Roosevelt St., Baton Rouge, La. 1952.
- Newton, Capt. Earl T., Jr., 899 Tank Bn., APO 165, % Postmaster, New York, N.Y. 1942.
- Nice, Margaret M., 5725 Harper Ave., Chicago 37, Ill. 1921 (1950) [L.].
- Nichols, Charles K., 212 Hamilton Rd., Ridgewood, N. J. 1936.
- Nichols, John T., American Museum of Natural History, New York 24, N.Y. 1909.
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- Nichols, Walter F., 2437 Lambert Dr., Pasadena 8, Calif. 1938.
- Nicholson, Donald J., 1224 Palmer St., Orlando, Fla. 1911.
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- Nielsen, Beatrice W., Rt. 1, Box 808, Kauffman Ave., Red Bluff, Calif. 1942.
- Nielsen, Joseph A., 253 Warren St., Brooklyn 2, N.Y. 1954.
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- Nolan, Val, Jr., School of Law, Indiana Univ., Bloomington, Ind. 1956.
- Norman, Edward, 181 Stage Harbor Rd., Chatham, Mass. 1951.
- Norris, Robert A., 535 Powderhouse Rd., Aiken, S. C. 1949.
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 Oberholser, Harry C., 2933 Berkshire Rd., Cleveland Hts., Cleveland 18, Ohio. 1904.
 O'Callaghan, T. C., Maromaku R.D., Bay of Islands, Northland, New Zealand. 1955.
 Odium, Gordon C., Race Rocks Lightstation, % Pilotage Authority, 200 Dallas Rd., Victoria, British Columbia, Canada. 1948.
 Odom, Mrs. Edgar R., Box 458, Orange, Texas. 1951.
 Ogilvie, Philip W., 9550 Faywood St., Bellflower, Calif. 1956.
 O'Keefe, Charlotte L., 4768 W. Sixth Ave., Vancouver 8, British Columbia, Canada. 1955.
 Olsen, Mrs. Gordon B., Shell Development Co., 4560 Horton St., Emeryville 8, Calif. 1956.
 Olson, Andrew C., Jr., San Diego State College B-173, San Diego 15, Calif. 1940.
 Olson, Leo B., 835 S. First St., DeKalb, Ill. 1951.
 O'Neil, Norah S., 1311 Bonham St., Commerce, Texas. 1951.
 Orr, Mary T., Box 183, Reserve, N.M. 1954.
 Orr, Robert T., California Academy of Sciences, Golden Gate Park, San Francisco 18, Calif. 1931.
 Orth, Robert E., Rt. 1, Box 774, Grand Ave., Elsinore, Calif. 1951.
 Owre, Oscar T., Jr., 3916 Irvington Ave., Coconut Grove, Miami 33, Fla. 1937.

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 Palmella, Duke of, 140 Rua da Escola Politecnica, Lisbon, Portugal. 1954.
 Palmer, C. Mortimer, Jr., Box 414, Tombstone, Ariz. 1952.
 Palmer, Fletcher G., 212 W. Primrose St., Placencia, Calif. 1942.
 Palmer, Ralph S., New York State Museum, State Education Bldg., Albany 1, N.Y. 1951.
 Paludan, Knud, Vildtbiologisk Station, Kalo, Ronde, Denmark. 1954.
 Park, Charles F., Jr., 1431 Arcadia Pl., Palo Alto, Calif. 1947.
 Parker, Clarence J., 821 N. Garfield Ave., Alhambra, Calif. 1938.
 Parkes, Kenneth C., Section of Birds, Carnegie Museum, Pittsburgh 13, Pa. 1947.
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 Parratt, Lloyd P., 402 Oakdale Dr., Claremont, Calif. 1956.
 Parsons, Robert P., Rt. 2, Box 252, Carmel, Calif. 1951.
 Patrick, Leon, 1208 Virginia Way, La Jolla, Calif. 1955.
 Patterson, Elizabeth C., 15862 La Forge St., Whittier, Calif. 1955.
 Patterson, John E., 2300 Siskiyou Blvd., Ashland, Ore. 1948.
 Patterson, Theresa H., 544 S. El Molino Ave., Pasadena, Calif. 1926 (1926) [L.].
 Paul, Lucius H., 51 Riverview Pl., Rochester 8, N.Y. 1913.
 Paulson, Richard E., National Research Council, 2101 Constitution Ave., Washington 25, D.C. 1948.
 Payne, Donald E., Rt. 4, Box 504, Hood River, Oregon. 1946.
 Payne, Everitt V., 18152 LeMay St., Reseda, Calif. 1951.
 Paynter, Raymond A., Jr., Museum of Comparative Zoology, Harvard Univ., Cambridge 38, Mass. 1946.
 Pearce, Theed, Comox, Vancouver Island, British Columbia, Canada. 1927.
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 Perley, Mrs. Lyman O., 520 S. 31st St., No. 8, Omaha, Nebr. 1927 (1927) [L.].
 Perry, Alfred E., 4724 Franklin Rd., Boise, Idaho. 1952.
 Peters, Elizabeth J., 851 Strada Vecchia Rd., Los Angeles 24, Calif. 1956.
 Petersen, Peter C., Jr., 620 E. 30th St., Davenport, Iowa. 1953.
 Peterson, James G., Box 462, San Jose, Calif. 1934.
 Peterson, Roger T., Neck Road, Old Lyme, Conn. 1939.
 Pettingill, Olin S., Jr., Wayne, Maine. 1934 (1948) [L.].
 Peyton, Laurence G., R. D. 2, Box 261, Fillmore, Calif. 1909 (1922) [L.].
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 Phelps, James H., 717 S. 4th Ave., Pocatello, Idaho. 1944.
 Phelps, William H., Apartado 2009, Caracas, Venezuela. 1941.
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 Phillips, Allan R., 113 Olive Rd., Tucson, Ariz. 1933 (1948) [L.].
 Phillips, Grace H., 1237½ S. Bronson Ave., Los Angeles 19, Calif. 1955.
 Phillips, William B., 137 W. 81st St., New York 24, N.Y. 1951.
 Pickering, Robert, 66 Menno St., Waterloo, Ontario, Canada. 1952.

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 Pierce, Fred J., Winthrop, Iowa. 1948.
 Pierce, Robert A., 1222 80th St., West Des Moines, Iowa. 1945.
 Pinkas, Leo, 3127 Volk Ave., Long Beach 11, Calif. 1953.
 Pitelka, Frank A., Museum Vertebrate Zoology, Berkeley 4, Calif. 1940.
 Piternick, George, 1174 Cragmont Ave., Berkeley 8, Calif. 1951.
 Plann, Florence M., 157 S. Los Robles Ave., Pasadena, Calif. 1956.
 Platford, Sidney D., 152 W. Duarte Rd., Arcadia, Calif. 1935.
 Plath, Karl, 114 S. East Ave., Oak Park, Ill. 1954.
 Plymell, Florence D., 1241 Bush St., San Francisco 9, Calif. 1950.
 Poole, Cecil A., 1764 Topeka Ave., San Jose 26, Calif. 1941.
 Porter, Eliot F., Rt. 1, Box 33, Santa Fe, N.M. 1946.
 Porter, Richard D., Dept. Wildlife Management, A. & M. College of Texas, College Station, Texas. 1949.
 Potter, Mrs. George C., 2111 Malvern Rd., Charlotte 7, N.C. 1951.
 Pough, Richard H., 33 Highbrook Ave., Pelham 65, N.Y. 1926.
 Poyser, Florence E., Box 1, Boulder City, Nev. 1952.
 Pratt, Helen S., 2451 Ridge View Ave., Los Angeles 41, Calif. 1940.
 Pray, Russell H., 662 Santa Rosa Ave., Berkeley 7, Calif. 1948.
 Presnall, Clifford C., 4923 Earlston Dr., Washington 16, D.C. 1931.
 Price, John B., 532 Alvarado Row, Stanford, Calif. 1926.
 Price, Ruth M., 5255 Glasgow Way, Los Angeles 45, Calif. 1942.
 Pringle, Cornelia C., 1816 Vallejo St., San Francisco, Calif. 1915 (1921) [L.].
 Pritchard, C. G., 2535 T St., Lincoln, Nebr. 1947.
 Prosser, Capt. Albert L., Box H, Springvale, Maine. 1955.
 Pulich, Warren M., 2720 Frazier Ave., Fort Worth 10, Texas. 1941.
 Pursell, William M., 511 Neilson St., Berkeley 7, Calif. 1926.
 Putman, William L., Dom. Entomological Lab., Vineland Sta., Ontario, Canada. 1947.
 Pyburn, William F., Dept. Zoology, Univ. Texas, Austin 12, Texas. 1955.
 Pyle, Robert L., 4037 Eighth Ave. N.E., Seattle 5, Wash. 1950.

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 Quay, Wilbur B., Museum of Zoology, Univ. Michigan, Ann Arbor, Mich. 1947.
 Quigley, Raymond, Jr., 14008 Lanning Dr., Whittier, Calif. 1937.

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 Ragan, Calvin, Box 7, Bell, Calif. 1952.
 Raitt, Ralph J., Jr., Museum of Vertebrate Zoology, Berkeley 4, Calif. 1954.
 Ramey, Bessie H., 4305 Elena St., Culver City, Calif. 1955.
 Rand, Austin L., Chicago Natural History Museum, Roosevelt Rd. and Lake Shore Dr., Chicago 5, Ill. 1955.
 Randall, Clarence B., 38 Dearborn St., Chicago 3, Ill. 1951.
 Randolph, Evan, Seminole and Chestnut Aves., Philadelphia 18, Pa.
 Ransom, Maud B., 3317 S.W. 11th Ave., Apt. 4, Portland 1, Ore. 1952.
 Ransom, Webster H., 9676 Evergreen Dr., Vuccrest, Bellevue, Wash. 1921.
 Rapp, William F., Jr., 430 Ivy Ave., Crete, Nebr. 1941.
 Rausch, Robert L., Arctic Health Research Center, Box 960, Anchorage, Alaska. 1952.
 Ray, Mrs. Milton S., 64 Spencer Lane, Atherton, Calif. 1948.
 Raymond, Francis, Box 2371, Laguna Beach, Calif. 1950.
 Read, Bayard W., Upper Dogwood Lane, Rye, N.Y. 1949.
 Rechnitzer, Andreas B., Scripps Inst. Oceanography, Univ. California, La Jolla, Calif. 1954.
 Reed, Richard H., Box 424, Coolidge, Ariz. 1947.
 Reeder, William G., 5464 Fifth Ave., Los Angeles 43, Calif. 1946.
 Rehfish, Carol, 335 Delgado St., Santa Fe, N.M. 1951.
 Reichert, Mrs. R. J., 14 W. First St., Mount Vernon 15, N.Y. 1950.
 Reinelt, Mrs. Frank, 344 Arroyo Seco, Santa Cruz, Calif. 1956.
 Reis, C. O., 646 Juanita Ave., Los Angeles 4, Calif. 1917.
 Renetzky, Andrew, 1008 Palm St., San Luis Obispo, Calif. 1949.
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 Reuther, Lt. Ronald T., AO-3010360, 780 T. C. Sq., APO 253, % P.M., New York, N.Y. 1946.
 Reynolds, Harold C., Museum of Vertebrate Zoology, Berkeley 4, Calif. 1946.
 Reynolds, T. Eric, 140 Estates Dr., Piedmont 11, Calif. 1934.
 Rhodes, Robert H., 2914 Clune Ave., Venice, Calif. 1955.

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- Richardson, Carl, Trail, Ore. 1925.
- Richardson, Ethel E., 3033 Community Ave., La Crescenta, Calif. 1941.
- Richardson, Frank, Dept. Zoology, Univ. Washington, Seattle 5, Wash. 1935.
- Richardson, Walter L., Rt. 3, Box 1094, Porterville, Calif. 1943.
- Richdale, Lancelot E., 23 Skibo St., Kew, Dunedin, New Zealand. 1944.
- Richmond, Stanley M., 331 Eugene Medical Center, Eugene, Ore. 1951.
- Richter, Carl H., 703 Main St., Oconto, Wis. 1948.
- Richter, G. William, Box 365, Canfield, Ohio. 1955.
- Rigby, Mrs. Douglas, Sedona, Ariz. 1951.
- Ripley, S. Dillon, Peabody Museum, New Haven 11, Conn. 1954.
- Rising, James D., 4406 Sunrise Dr., Kansas City 23, Mo. 1955.
- Robbins, Chandler S., R. D. 1, Brooklyn Bridge Rd., Laurel, Md. 1954.
- Roberts, Bert, 6951 33rd St. N.W., Washington 15, D. C. 1947.
- Roberts, Frances F., 1134 Glendon Ave., Los Angeles 24, Calif. 1942 (1943) [L.].
- Robertson, Frank D., 133 S. 12th St., San Jose, Calif. 1956.
- Robertson, Howard, 157 Wilton Dr., Los Angeles 4, Calif. 1896 (1926) [L.], (1949) [Honorary].
- Robertson, John McB., 1677 W. Ninth St., Pomona, Calif. 1913 (1949) [Honorary].
- Robertson, Ruth B., 567 Vistamount Ave., Berkeley 8, Calif. 1955.
- Robertson, William B., Jr., 2245 S.W. 17th Terr., Miami, Fla. 1955.
- Robinson, Roy G., Jr., 1320 W. 29th St., Los Angeles 7, Calif. 1952.
- Rockefeller, William A., Rm. 2610, 52 Wall St., New York 5, N.Y. 1952.
- Roesler, M. Stuart, June Road, Cos Cob, Conn. 1949.
- Roest, Aryan I., Biological Sciences Dept., State Polytechnic College, San Luis Obispo, Calif. 1947.
- Rogers, Caroline W., 1029 Vallejo St., Santa Rosa, Calif. 1938.
- Rooney, James, Jr., 1514 S. 12th Ave., Yakima, Wash. 1948.
- Ross, Aaron B., 3417 Fillmore Ave., Ogden, Utah. 1947.
- Ross, C. Chandler, 710 Wolcott Dr., "Cherokee," Philadelphia 18, Pa. 1948.
- Ross, Hollis T., 29 S. Second St., Lewisburg, Pa. 1936.
- Ross, Roland C., 1820 Bushnell Ave., South Pasadena, Calif. 1920.
- Ross, R. Dudley, 16510 Las Casas Pl., Pacific Palisades, Calif. 1955.
- Roth, Edgar S., 7024 Melrose Ave., Los Angeles 38, Calif. 1949.
- Rowinski, Ludwig J., Box 86, College, Alaska. 1948.
- Rowley, J. Stuart, 305 Sequoia Dr., Pasadena 2, Calif. 1928.
- Rubey, William W., 5216 Westwood Dr., Washington 16, D. C. 1949.
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- Salt, George W., Dept. Zoology, Univ. California, Davis, Calif. 1947.
- Salter, Robert L., 711 Shoshone St., Boise, Idaho. 1955.
- Sampson, Walter B., 1005 N. San Joaquin St., Stockton 3, Calif. 1894.
- Sams, James R., 4348 Hilldale Rd., San Diego 16, Calif. 1944.
- Sanchez-Mejorada, Carlos, Jr., Montes Urales 632, Lomas de Chapultepec, Mexico City 10, D. F., Mexico. 1948.
- Sanders, Earl, Howard Payne College, Brownwood, Texas. 1946.
- Sather, Carlyle W., 7880 Mission St., Colma, Calif. 1952.
- Satter, John M., 4500 Millersville Rd., Indianapolis 5, Ind. 1954.
- Saunders, Aretas A., Box 141, Canaan, Conn. 1909.
- Savage, James, Buffalo Athletic Club, Buffalo 3, N.Y. 1937.
- Sawyer, E. W., 425 N. June St., Los Angeles 4, Calif. 1952.
- Schadle, Daniel P., 1029 E. Tuckey Lane, Phoenix, Ariz. 1954.
- Schaefer, Hugh F., 825 Merchants Rd., Rochester 9, N.Y. 1946.
- Schmidt, Harold A., 317 E. El Segundo Blvd., Los Angeles 61, Calif. 1952.

- Schmidt, Thomas B., 3700 Sharon St., Harrisburg, Pa. 1948.
- Schneider, Fred A., % Warren Dried Fruit Co., San Jose, Calif. 1893 (1949) [Honorary].
- Schoenborn, Harry, Rt. 1, Box 164, Molalla, Ore. 1950.
- Scholes, R. T., U.S.O.M., American Embassy, La Paz, Bolivia, % Dept. of State Mail Room, Washington 25, D.C. 1948.
- Schorger, A. W., 168 N. Prospect Ave., Madison 5, Wis. 1928.
- Schramm, Wilson C., 321 Lensington Rd., Syracuse 10, N.Y. 1954.
- Schulz, Kenneth R., 4008 Rhoda Ave., Oakland 2, Calif. 1949.
- Schumacher, Mrs. Hall L., 7027 Sycamore Ave., Seattle 7, Wash. 1953.
- Schumm, William G., 302 C St., La Porte, Ind. 1945.
- Schuster, Robert O., 3932 Ardley Ave., Oakland 2, Calif. 1945.
- Schwartz, Paul A., Jr., Apartado 1766, % York Venezuela, Caracas, Venezuela. 1952.
- Scott, Mrs. Frank A., 1508 La Loma Ave., Berkeley 8, Calif. 1936.
- Scott, Frederic R., 115 Kennondale Lane, Richmond 26, Va. 1947.
- Scott, Mrs. C. Emlen, Box 12, Whitmore, Shasta Co., Calif. 1942.
- Scott, Tom K., Box 6, Braddock Heights, Md. 1952.
- Scott, Walter, Box 256, Placentia, Calif. 1947.
- Seeber, Edward L., 213 Columbia St., Ithaca, N.Y. 1946.
- Seibert, Henri C., Dept. Zoology, Ohio Univ., Athens, Ohio. 1947.
- Seibert, Milton L., Jr., Rt. 1, Box 220-A, Sunol, Calif. 1937.
- Seibert, Robert F., 17 Canoe Brook Rd., Short Hills, N.J. 1955.
- Selander, Robert K., Dept. Zool., Univ. Texas, Austin, Texas. 1946.
- Selle, Raymond M., 1562 Munson Ave., Los Angeles 42, Calif. 1948.
- Severaid, J. Harold, Dept. Life Sciences, Sacramento State College, Sacramento 19, Calif. 1946.
- Shackleton, Walter H., Rt. 1, Box 76-A, Prospect, Ky. 1953.
- Shaftesbury, A. D., Dept. Biology, Women's College, Univ. North Carolina, Greensboro, N.C. 1945.
- Sharpless, Evelyn M., Pauma Valley, Calif. 1956.
- Shaub, Benjamin M., 159 Elm St., Northampton, Mass. 1948.
- Shaughnessy, Winslow M., 657 Forest Ave., Glen Ellyn, Ill. 1954.
- Shaw, Catherine D., 7142 Marshfield Way, Hollywood 46, Calif. 1951.
- Shaw, Charles R., 554 Ursuline Dr., Baton Rouge 2, La. 1949.
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- Shellenberger, Emmett L., Akron Museum of Natural History, 500 Edgewood Ave., Akron 7, Ohio. 1955.
- Shelton, Leonard A., 313 First National Bldg., Pomona, Calif. 1945.
- Shepard, Frank P., Jr., Meadow Lane, Greenwich, Conn. 1951.
- Sherman, George L., Upper Lake, Calif. 1946.
- Shipley, Donald D., Dept. Natural Sciences, Long Beach State College, Long Beach 15, Calif. 1955.
- Short, Lester L., Jr., Dept. Conservation, Cornell Univ., Ithaca, N.Y. 1954.
- Shufeldt, Robert W., 4201 S. Four Mile Run Dr., Arlington 4, Va. 1948.
- Sibley, Charles G., Fernow Hall, Cornell Univ., Ithaca, N.Y. 1938 (1953) [L.].
- Sibley, Gretchen, 6006 Overhill Dr., Apt. 4, Los Angeles 43, Calif. 1950.
- Siemens, Mrs. Dan, 5179½ Village Green, Los Angeles 16, Calif. 1955.
- Simmons, Edward M., % E. A. McIlhenny, Avery Island, La. 1943 (1943) [L.].
- Simmons, Mrs. William W., 2742 N. Maryland Ave., Milwaukee 11, Wis. 1945.
- Sims, Mrs. R. M., % R. M. Sims, Jr., Courthouse, San Rafael, Calif. 1933.
- Singleton, Albert R., 3968 Marburg Ave., Cincinnati 9, Ohio. 1949.
- Skelton, Kathleen G., 353 W. 57th St., New York 19, N.Y. 1952 (1952) [L.].
- Skillen, Donald R., 419 Garfield Ave., South Pasadena, Calif. 1927.
- Skinner, Milton P., 438 Locust Ave., Long Beach 2, Calif. 1915 (1920) [L.].
- Skutch, Alexander F., El Quizarra, San Isidro del General, Costa Rica. 1944.
- Small, Arnold, 5838 W. 88th St., Los Angeles 45, Calif. 1954.
- Smith, Anna Margaret, 207 Alexander Ave., Larkspur, Calif. 1934.
- Smith, Carolyn M., 1221 W. 90th Pl., Los Angeles 44, Calif. 1953 (1953) [L.].
- Smith, Clarence F., 1152 Laurel St., Berkeley, Calif. 1928.
- Smith, Emily D., 19651 Glen Una Dr., Los Gatos, Calif. 1921 (1955) [L.].
- Smith, Harry M., 1602 State St., Columbus, Ind. 1952.
- Smith, Harry R., 133 Monterey, Santa Cruz, Calif. 1954.
- Smith, Hubert L., % O. R. Lucas, 232 S. Park View St., Los Angeles 57, Calif. 1956.
- Smith, Josephine E., 29 Mosswood Rd., Berkeley 4, Calif. 1928.
- Smith, Lorin P., 2560 61st Ave., Oakland 5, Calif. 1930.
- Smith, Patricia F., 2215 Rose St., Berkeley, Calif. 1956.

- Smith, Robert L., R.D. 1, Reynoldsville, Pa. 1947.
- Smith, Thomas A., 843 Indian Rock Ave., Berkeley 7, Calif. 1942.
- Smith, Walton A., 1059 Pennsylvania Ave., Beaumont, Calif. 1955.
- Smith, X. Martin, 816 S. Windsor Blvd., Los Angeles 5, Calif. 1948.
- Smythe, Paul E., Box 1151, Beverly Hills, Calif. 1955.
- Snell, Charles H., 4915 48th Ave., Red Deer, Alberta, Canada. 1926.
- Snider, Patricia R., 3620 Gold St., Apt. 3, Los Alamos, N. M. 1954.
- Snow, Angeline W., 21441 Roaring Water Way, Los Gatos, Calif. 1950.
- Snyder, Beth C., 571 Dwight Pl., Berkeley, Calif. 1955.
- Snyder, Dorothy E., The Peabody Museum, 161 Essex St., Salem, Mass. 1952.
- Snyder, L. L., Royal Ontario Museum, 100 Queens Park, Toronto 5, Ontario, Canada. 1924.
- Sooter, Clarence A., U. S. Public Health Service, Box 625, Greeley, Colo. 1945.
- Southern, William, 614 Prairie St., Clane, Mich. 1956.
- Speirs, Mrs. J. Murray, Coble Hill, R. R. 2, Pickering, Ontario, Canada. 1945.
- Spencer, Don, 88 Secor Rd., Scarsdale, N.Y. 1953.
- Spencer, John S., 1640 The Strand, Reno, Nev. 1955.
- Spofford, Walter R., State Univ. N. Y. Medical College, 766 Irving Ave., Syracuse 10, N.Y. 1954.
- Sprinkle, Roger, 423 Indiana Ave., Chinook, Mont. 1936.
- Sprunt, Alexander, IV, The Crescent, Charleston 44, S. C. 1952.
- Staebler, Arthur E., Biology Dept., Fresno State College, Fresno, Calif. 1945.
- Stager, Kenneth E., Los Angeles County Museum, Exposition Park, Los Angeles 7, Calif. 1935.
- Stallcup, Leland L., 6227 Buenaventura, Oakland 5, Calif. 1956.
- Stallcup, William B., Biology Dept., Southern Methodist Univ., Dallas 5, Texas. 1951.
- Stanley, Emerson W., Box 131, Garden Grove, Calif. 1946.
- Stanley, Willard F., Teachers College, State Univ. New York, Fredonia, N.Y. 1948.
- Stanton, John S., Box 2495, Carmel, Calif. 1953.
- Steele, Paul H., Box 935, Sacramento, Calif. 1947.
- Stein, Robert C., Laboratory of Ornithology, Fernow Hall, Cornell Univ., Ithaca, N.Y. 1951.
- Stern, Ralph J. A., 305 Clay St., San Francisco 11, Calif. 1952.
- Sterne, Marie E., 3027 Benvenue Ave., Berkeley 5, Calif. 1952.
- Stettenheim, Peter, Division of Birds, Museum Zoology, Univ. Michigan, Ann Arbor, Mich. 1952.
- Steusloff, Ivan, 245 N. 13th St., Salem, Ore. 1944 (1944) [L.].
- Stevenson, James O., Fish and Wildlife Service, Dept. of Interior, Washington 25, D. C. 1928.
- Steward, Orville M., Box 19, Fordham Rd. Sta., Bronx 58, N.Y. 1950.
- Stewart, James R., Jr., 844 Natchez St., Shreveport, La. 1955.
- Stewart, Paul A., 8640 N. State St., Westerville, Ohio. 1930 (1943) [L.].
- Stewart, Robert E., Patuxent Research Refuge, Laurel, Md. 1941.
- Stillwell, Jerry E., R. F. D. 2, Fayetteville, Ark. 1936.
- Stirrett, George M., Canadian Wildlife Service, Old Arts Bldg., Queen's University, Kingston, Ontario, Canada. 1955.
- Stockwell, Lillian M., 1114 Bay St., Alameda, Calif. 1954.
- Stoddard, Herbert L., Sr., Sherwood Plantation, Rt. 5, Thomasville, Ga. 1914.
- Stone, Edgar N., 3867 Washington St., San Francisco, Calif. 1947.
- Stone, Lois C., 1615 La Vereda Rd., Berkeley 9, Calif. 1946.
- Stone, Ned W., 839 Galvin Dr., El Cerrito 6, Calif. 1939.
- Stoner, Emerson A., 285 E. L St., Benicia, Calif. 1918.
- Storer, Robert W., Museum Zoology, Univ. Michigan, Ann Arbor, Mich. 1941 (1952) [L.].
- Storer, Tracy I., Dept. Zoology, Univ. California, Davis, Calif. 1910.
- Stott, Ken W., Jr., 3040 Helix St., Spring Valley, Calif. 1941.
- Stowell, Mrs. Ellery C., 670 Santa Rosa Ave., Berkeley 7, Calif. 1949.
- Straw, Richard M., Los Angeles State College, 855 N. Vermont Ave., Los Angeles 29, Calif. 1948.
- Street, Phillips B., Rt. 1, Chester Springs, Pa. 1948.
- Strehlow, Elmer W., Box 1443, Milwaukee 1, Wis. 1945 (1946) [L.].
- Stringham, Emerson, Box 986, Kerrville, Texas. 1944.
- Struthers, Dana R., 1901 Jackson St., San Francisco, Calif. 1956.
- Stuart, Lyman K., 501 W. Maple Ave., Newark, N.Y. 1956.
- Stuebben, Mrs. C. P., 48 Highgate Rd., Berkeley 7, Calif. 1952.
- Suffel, G. Shumway, 1105 N. Holliston Ave., Pasadena 6, Calif. 1926.
- Sumner, Lowell, Three Rivers, Calif. 1924.
- Suthard, James G., 1881 Raymond Ave., Long Beach 6, Calif. 1938.

- Sutton, George M., Dept. Zoology, Univ. Oklahoma, Norman, Okla. 1924 (1954) [L.].
 Sweeney, R. D., N. 460 Las Palmas, Los Angeles 4, Calif. 1949.
 Swinebroad, Jeff, Dept. Botany and Zoology, Douglass College, Rutgers Univ., New Brunswick, N. J. 1955.
 Swinehart, Durward B., Jr., 2109 Juanita Lane, Sacramento 21, Calif. 1953.

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 Taber, Wendell, 33 Lexington Ave., Cambridge 38, Mass. 1935.
 Tabor, Ava R., 305 Canal Ave., Thibodaux, La. 1955.
 Taft, John E., 352 Glen Ellen, Ventura, Calif. 1954.
 Tainter, Mrs. Stanton L., 2226 Berkeley St., Salt Lake City, Utah. 1956.
 Talmadge, Robert R., Box 71, Willow Creek, Calif. 1939.
 Tanner, Vasco M., Brigham Young Univ., Provo, Utah. 1919.
 Tashian, Richard E., 413 W. 117th St., New York 27, N.Y. 1951.
 Taylor, Janice F., 408 Panoramic Way, Berkeley 4, Calif. 1955.
 Taylor, Lewis W., Div. Poultry Husbandry, Univ. California, Berkeley 4, Calif. 1931.
 Taylor, Robert L., 810 Highland Dr., Flintridge, Pasadena 3, Calif. 1944.
 Taylor, Walter P., 425 W. Harrison St., Claremont, Calif. 1905.
 Taylor, Mrs. William E., 4667 Ironwood St., Saginaw, Mich. 1956.
 Teachenor, Dix, 1020 W. 61st St., Kansas City 13, Mo. 1922.
 Teale, Edwin W., 93 Park Ave., Baldwin, L. I., N.Y. 1947.
 Terres, John K., 345 E. 57th St., New York 22, N.Y. 1947.
 Terry, Anne B., 1940 Waverley St., Palo Alto, Calif. 1937.
 Test, Frederick H., Dept. Zoology, Univ. Michigan, Ann Arbor, Mich. 1936.
 Tevis, Lloyd P., Jr., Dept. Zoology, Univ. California, Davis, Calif. 1940.
 Thatcher, Vernon E., 210 Beatty St., Medford, Ore. 1945.
 Thomas, Cedric, 12196 Laurel Terrace Dr., North Hollywood, Calif. 1954.
 Thomas, Evelyn H., Apt. 1, 407 E. Pasadena St., Pomona, Calif. 1940.
 Thomas, Gerald B., 339 W. 82nd St., Inglewood, Calif. 1949.
 Thomas, Harriet P., 32 Stoddard Way, Berkeley 8, Calif. 1955.
 Thomas, Ray, 600 Sarbonne Rd., Los Angeles 24, Calif. 1953.
 Thompson, Arthur R., 1112 Scofield Dr., Glendale 5, Calif. 1952.
 Thompson, William L., Ops. Research Office, Johns Hopkins Univ., 7100 Connecticut Ave., Chevy Chase, Md. 1953.
 Thomson, Isabel A., 5939 Shafter Ave., Oakland 18, Calif. 1919.
 Thomssen, Sylvia L., 56 Avon Rd., Berkeley 7, Calif. 1952.
 Thornburg, Mrs. R. J., Box 6086, Tucson, Ariz. 1952.
 Thorne, Oakleigh, II, 1707 Hillside Rd., Boulder, Colo. 1947.
 Tice, Stanford C., 78 Manhattan Ave., New York 25, N.Y. 1956.
 Tinkham, Ernest R., Box 306, Indio, Calif. 1942.
 Todd, Henry O., Jr., Box 259, Murfreesboro, Tenn. 1946.
 Todd, W. E. Clyde, Carnegie Museum, Pittsburgh 13, Pa. 1909.
 Tomich, P. Quentin, Dept. Zoology, Univ. California, Davis, Calif. 1943.
 Tordoff, Harrison B., Museum of Natural History, Univ. Kansas, Lawrence, Kan. 1951.
 Townes, George F., 209 Masonic Temple, Greenville, S. C. 1953.
 Trask, Parker D., 240 Southampton Ave., Berkeley 7, Calif. 1934.
 Trautman, Milton B., 618 S. Fifth St., Columbus 6, Ohio. 1946.
 Traylor, Melvin A., Jr., 759 Burr Ave., Winnetka, Ill. 1950.
 Trost, Henry J., 2344 Ulloa St., San Francisco 16, Calif. 1924.
 Trousdale, Mrs. H. K., 5923 La Salle Ave., Oakland 11, Calif. 1953.
 Troxell, Inez D., 636 Coventry Rd., Berkeley 7, Calif. 1933.
 Tubb, John A., 250 Riversdale Rd., Hawthorne, Victoria, Australia. 1948.
 Tucker, Mrs. Carll, Mount Kisco, N.Y. 1927 (1931) [L.].
 Tucker, Harold M., The College of Idaho, Caldwell, Idaho. 1955.
 Twiss, Alfred R., 2359 Gails Ave., Chehalis, Wash. 1955.
 Twisselman, William H., 415 Capitol St., Salinas, Calif. 1935.
 Twomey, Arthur C., Carnegie Museum, Pittsburgh 13, Pa. 1952.
 Tyler, John G., 1115 Thorne Ave., Fresno, Calif. 1905 (1920) [L.].

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 Unglish, Will E., 345 N. Rosanna St., Gilroy, Calif. 1910.
 Urabec, John H., 1136 W. Sixth St., Los Angeles 17, Calif. 1951.

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- Van Cleve, G. Bernard, 323 S. Fairmount St., Pittsburgh 32, Pa. 1954.
 Van Deusen, Hobart M., 12 Highland Ave., Montclair, N. J. 1940.
 Vane, Robert F., 600 Dows Bldg., Cedar Rapids, Iowa. 1948.
 Van Fleet, Clark C., 835 Fourth St., Lakeport, Calif. 1941.
 Van Hoose, South G., Museum of Natural History, Univ. Kansas, Lawrence, Kan. 1955.
 Van Loo, Joseph A., Jr., 3804 S.E. 13th Ave., Portland, 2, Ore. 1955.
 Van Scyoc, Evelyn E., 133 North C St., Apt. 4, Exeter, Calif. 1950.
 Van Tyne, Josselyn, Museum of Zoology, Univ. Michigan, Ann Arbor, Mich. 1931.
 Vaughan, Alan W., 1808 Duchess Ave., West Vancouver, British Columbia, Canada. 1955.
 Vaughan, William C., Church St., Youngstown, N.Y. 1945.
 Verges, Eugene M., II, 1126 Beacon St., Brookline 46, Mass. 1931.
 Vessel, M. F., San Jose State College, San Jose 14, Calif. 1950.
 Voge, Marietta, Dept. Infectious Diseases, Univ. California Medical School, Los Angeles 24, Calif. 1949.
 Von Bloeker, Jack C., Jr., Dept. Life Sciences, Los Angeles City College, Los Angeles 29, Calif. 1927 (1950) [L.].
 Von Bloeker, Jack C., III, 871 N. Kenmore Ave., Hollywood 29, Calif. 1955.
 Von Hafften, Paul R., 112 Arguello Blvd., San Francisco, Calif. 1950 (1951) [L.].
 Von Siebold Dingle, Edward, Middleburg Plantations, Huger, S. C. 1953.
 Vowels, William G., 5046 Greenbush Ave., Van Nuys, Calif. 1940.

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 Wade, Otis H., 1806 Redesdale, Los Angeles 26, Calif. 1949.
 Wagner, Fred H., 4454 Hillcrest Dr., Madison 5, Wis. 1954.
 Wagner, Mrs. H. J., 818 E. Boulder St., Colorado Springs, Colo. 1951.
 Walker, Alex, Rt. 3, Box 190, Tillamook, Ore. 1911.
 Walker, Charles F., Museum Zoology, Univ. Michigan, Ann Arbor, Mich. 1942.
 Walker, Ernest P., Apt. 404, 3016 Tilden St. N.W., Washington 8, D. C. 1910.
 Walker, Kenneth L., 3224 N. 20th St., Tacoma 7, Wash. 1947.
 Walkinshaw, Lawrence H., 1703 Wolverine Tower, Battle Creek, Mich. 1934 (1949) [L.].
 Wallin, Kathleen L., 11543 36th St. N.E., Seattle 55, Wash. 1952.
 Wallmo, O. C., Box 254, F. E., College Station, Texas. 1954.
 Wallner, Alfred, 729 Second Ave. E., Kalispell, Mont. 1955.
 Walz, Francisco H., Reconquista 453, Buenos Aires, Argentina. 1955.
 Wanzer, James O., 3601 56th St., Sacramento 20, Calif. 1922.
 Ware, Georgie, 14170 Fox St., San Fernando, Calif. 1949.
 Warters, Mary-Ellen, 5115 Woodland Ave., Des Moines 12, Iowa. 1949.
 Washington, Mrs. Whiting, North Edgcomb, Maine. 1948.
 Watson, Frank G., Stony Acres, Rt. 2, Westport, Conn. 1934.
 Webb, Edward L., 254 E. Second St., Mesa, Ariz. 1954.
 Webb, William G., 5146 Oakwood Ave., La Canada, Calif. 1936.
 Weber, Dr. Walter M., U. S. Naval Hospital, Annapolis, Md. 1955.
 Webster, J. Dan, Hanover College, Hanover, Ind. 1942.
 Weedmark, Clara S., 11234 Elkwood St., Sun Valley, Calif. 1951.
 Weise, Charles M., Biol. Dept., Fisk Univ., Nashville 8, Tenn. 1952.
 Weiser, Charles S., Wynyham Hills, York, Pa. 1920.
 Wells, Oliver N., Edenbank Farm, 315 Vedder Rd., Sardis, British Columbia, Canada. 1956.
 Werner, James R., Box 145, Goodyear, Ariz. 1953.
 Werning, Joseph R., 1700 Third Ave., Walnut Creek, Calif. 1955.
 West, Henry C., 4660 E. 42nd St., Indianapolis 18, Ind. 1953.
 Weston, Henry G., Jr., Dept. Biological Sciences, San Jose State College, San Jose 14, Calif. 1943.
 Wetherbee, David K., R. D., Pomfret Center, Hampton, Conn. 1947.
 Wetmore, Alexander, U. S. National Museum, Washington, D. C. 1909 (1927) [L.], (1956) [Honorary].
 Weydemeyer, Winton, Fortine, Mont. 1936.
 Whelan, Mary Elizabeth, 310 Amity St., Muskegan, Mich. 1953.
 Whitaker, Lovie M., 1204 W. Brooks St., Norman, Okla. 1948.
 White, Ensign Danforth E., 121½ S. Fifth St., Apt. 1, Kingsville, Texas. 1952.
 Whitehead, S. S., Box 393, Corcoran, Calif. 1953.
 Whitney, Nathaniel R., Jr., 4350 Meadowwood St., Rapid City, S. D. 1945.
 Wick, William Q., Box 735, Conway, Wash. 1955.
 Wiederhoeft, Waldemar L., R. R. 4, Box 663, Valley Center, Calif. 1948.
 Wiens, John A., 428 Chautauqua, Norman, Okla. 1954.

- Wiggin, Henry T., 151 Tappan St., Brookline 46, Mass. 1944.
- Wiggins, Ira L., Natural History Museum, Stanford Univ., Stanford, Calif. 1947.
- Wilder, Theodore G., 125 Oxford Rd., Waukesha, Wis. 1947.
- Wilhelm, Eugene J., Jr., 7334 Trenton, University City 14, Mo. 1954.
- Williams, A. D., 73 Hazelwood Ave., San Francisco 12, Calif. 1951.
- Williams, Alice L., 542 Anderson Rd., Davis, Calif. 1954.
- Williams, David R., 6053 Vantage Ave., North Hollywood, Calif. 1956.
- Williams, George C., The Rice Institute, Houston, Texas. 1947.
- Williams, Inez A., 73 Hazelwood Ave., San Francisco 12, Calif. 1951.
- Williams, John G., The Coryndon Museum, Box 658, Nairobi, Kenya, East Africa. 1953 (1953) [L.].
- Williams, Laidlaw O., R. F. D. 1, Box 152, Carmel, Calif. 1925.
- Williams, Ralph B., Box 2354, Juneau, Alaska. 1949 (1953) [L.].
- Williams, Raymond E., 1036 S. Bradshaw Ave., Monterey Park, Calif. 1950.
- Williams, Mrs. Will, Granite Sta., Bakersfield, Calif. 1939.
- Williamson, Francis S. L., Arctic Health Research Center, Box 960, Anchorage, Alaska. 1952.
- Williamson, Mrs. Mark A., 275 Hillcrest Dr., Rt. 1, Encinitas, Calif. 1948.
- Willis, Cornelius G., 1 Carter Ave., Sierra Madre, Calif. 1948.
- Willis, John S., 1375 E. Villa St., Pasadena 4, Calif. 1950.
- Willis, Orvin C., 243 W. 71st St., Los Angeles 3, Calif. 1952.
- Willits, Ethel S., 502 N. Pleasant, Lodi, Calif. 1946.
- Wilson, Belle, 304 N. Third St., Banning, Calif. 1943 (1948) [L.].
- Wilson, Calvin, 310 S. Third, East, Salt Lake City 4, Utah. 1952.
- Wilson, Ida Demay, 6204 Dry Creek Rd., Napa, Calif. 1939.
- Wilson, Paul T., Box 582, Kentfield, Calif. 1937.
- Wing, Harold F., 7165 Bunkerhill Rd., Jackson, Mich. 1948.
- Wing, Leonard W., 3875 Vorhis Rd., Ann Arbor, Mich. 1935.
- Winson, J. W., Box 584, Sumas, Wash. 1925.
- Winter, Frank C., 1101 Wilshire Blvd., Los Angeles 17, Calif. 1950.
- Wise, Robert W., Rt. 1, Box 350, Woodland, Calif. 1953.
- Wiseman, Philip K., Jr., Suite 10, 10328 Wilshire Blvd., Los Angeles 24, Calif. 1947.
- Wisner, Robert L., Scripps Inst. Oceanography, Field Activities, La Jolla, Calif. 1951.
- Wolfe, Lloyd R., Rt. 1, Kerrville, Texas. 1921.
- Wolff, John L., 859 North St., Peekskill, N.Y. 1948.
- Wolfson, Albert, Dept. Biological Sciences, Northwestern Univ., Evanston, Ill. 1943.
- Wolters, H. E., 28 Nikalaus-Becker Str., (22c) Geilenkirchen bei Aachen, Nordrhein-Westfalen, Western Germany (British Zone). 1954.
- Wood, Dale T., 636 Cortez Ave., Vista, Calif. 1940.
- Wood, Merrill, Dept. Zoology and Entomology, Pennsylvania State Univ., University Park, Pa. 1948.
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